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ECOLOGIC RELATIONS OF SOME FORAMINIFERA

BY

RICHARD D. NORTON

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INTRODUCTION

This problem was undertaken at the suggestion of Dr. T. Wayland Vaughan, Director of the Scripps Institution of Oceanography at La Jolla, California.

Material from fifteen localities was examined for the foraminifera. The samples range in depth from the beach to 2849 fathoms. With two exceptions, samples 3 and 14, the localities are all in the Floridian and West Indian regions.

A list of the samples, with the location, depth, and temperature follows:

Sample No. 1, b.s. 175a (T.W.V.) Golding Cay, Bahamas, beach temperature, 26.6° C during May.

Sample No. 2, b.s. 216 (T.W.V.) E. end Key West Island, Fla., beach, temperature range 21.5°–31.4° C.

Sample No. 3, Line no. 1 (A.G.M.) Murray Island, Australia, depth 1–1⅓ feet, temperature range 23°–28.8° C.

Sample No. 4, b.s. 120 (T.W.V.) Ft. Jefferson Moat, Tortugas, Fla., depth 2–3 feet, temperature range 22.3°–29° C.

Sample No. 5, b.s. 177 (T.W.V.) 2 miles west of S. Bight, Andros Island, Fla., mud 2 feet deep, depth 1 fathom, temperature range 21.5°–31.4° C.

Sample No. 6, Bird Key Harbor, Fla., depth 5½ fathoms, temperature range 22.6°–24.8° C.

Sample No. 7, b.s. 212 (T.W.V.) Tortugas, Fla., depth 8 fathoms, temperature range 22.6°–24.7° C.

Sample No. 8, b.s. 227 (T.W.V.) S. of Tortugas, Fla., depth 16 fathoms, temperature range 22.6°–24.7° C.

Sample No. 9, b.s. 100 (T.W.V.) S. of Key West, Fla., depth 60 fathoms, temperature about 20.6° C.
Sample No. 10, Albatross 2660, Lat. 28° 40′ N Long. 78° 46′ W, depth 504 fathoms, temperature 7.61° C.
Sample No. 11, Albatross 2751, Lat. 16° 54′ N Long. 63° 12′ W, depth 687 fathoms, temperature 4.44° C.
Sample No. 12, b.s. 85 (T.W.V.) Tongue of Ocean, about 14 miles E. of Andros Island, depth 800–825 fathoms, temperature 4.0° C.
Sample No. 13, b.s. 84 (T.W.V.) Tongue of Ocean, about 8 miles E. of Andros Island, depth 825 fathoms, temperature 4.0° C.
Sample No. 14, Albatross D4709, Lat. 10° 15.2′ S Long. 93° 40.8′ W, depth 2035 fathoms, temperature 1.83° C.
Sample No. 15, Bache 10190a, Lat. 28° 42′ N Long. 71° 32′ W, depth 2849 fathoms, temperature 2.0° C.

The temperatures at b.s. 175a (T.W.V.), b.s. 216 (T.W.V.), b.s. 120 (T.W.V.), b.s. 177 (T.W.V.), Bird Key Harbor, b.s. 212 (T.W.V.), b.s. 227 (T.W.V.), b.s. 100 (T.W.V.), b.s. 85 (T.W.V.), and b.s. 84 (T.W.V.) were obtained from a study of Doctor Vaughan's article, The Temperatures of the Florida Coral Reef Tract.[1] Temperatures at Bird Key Harbor in 5½ fathoms, and all deeper stations are based on subsurface records. A report by A. G. Mayer[2] furnished the temperature data at the Murray Island station. The temperatures at Albatross stations Nos. 2660, 2751, and D4709 were obtained from the Albatross records.[3] Temperature records from the red clay sample No. 15 were obtained from the United States Bureau of Fisheries' report on dredging and trawling at pelagic stations.[4]

I have divided the stations into bathymetric zones depending on depth and temperature as follows:

Zone A. Beach—5 fathoms, samples 1, 2, 4, 5.
Temperature range less than 21.5°–31.4° C.
Zone B. 5–60 fathoms, samples 6, 7, 8, 9.
Temperature range 18.9°–24.8° C.
Zone C. 500–825 fathoms, samples 10, 11, 12, 13.
Temperature range 4.0°–7.61° C.
Zone D. 2000–2850 fathoms, samples 14, 15.
Temperature range 1.83°–2.0° C.
Zones A and B are termed shallow water, Zone C intermediate depths, and Zone D, deep water.

A study is made of the occurrence of various types of foraminiferal life in these different zones, and their relative abundance.

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[1] Carn. Inst. of Wash., Publ. 213 (1918), Papers from Dept. Marine Biol., pp. 319–339.

[2] Mayer, A. G., Carn. Inst. of Wash., Publ. 213, p. 32.

[3] Agassiz, A., Reports on the scientific results of expedition to the Eastern Tropical Pacific.

[4] Record supplied to Dr. Vaughan by the U. S. Bureau of Fisheries.

Cushman[5] states that the Tortugas region is an especially favorable place for studying the shallow-water foraminiferal life because of the constancy of ecologic conditions. These conditions depend both on the high temperature of the water, and on the absence of land drainage areas in the immediate vicinity.

A note should be made on the peculiar conditions encountered at sample 13, b.s. 84 (T.W.V.) in 825 fathoms of water in the tongue of the ocean,[6] about eight miles east of South Bight on Andros Island, Bahama Islands. The fauna at this station shows not only assemblages of life characteristic of this depth, but also a large number of distinctly shallow-water types. It is very different in this respect from the other samples, taken in the deeper waters. A narrow oceanic channel, which was probably formed by a fault or series of faults, is present at this place. This channel shows a large shallow-water fauna near its middle portion, while a few miles farther from Andros Island at b.s. 85 (T.W.V.) fewer shallow-water species were encountered. These shallow-water forms were either washed out of their original habitat by the waves, or were carried up on the beach, and from there scattered about by winds. More representatives of the shallow-water fauna were carried to b.s. 84 than to b.s. 85.

The laboratory work and the original manuscript were completed in January 1927. The older foraminiferal classification scheme was followed. The next year, a revision of the report was begun, to conform with Doctor Cushman's latest publications on the reclassification of the foraminifera.[7, 8]

I wish to acknowledge the many helpful suggestions given me by Dr. T. Wayland Vaughan, and also to express my appreciation of the assistance given me by my wife in the revision of the report.

SYSTEMATIC DESCRIPTION

Family ASTRORHIZIDAE

Three genera and five species of this family were studied. They were all found in zone C, 500–825 fathoms, and were most abundant in sample 11 at 687 fathoms. The most common member of this group was *Rhabdammina discreta* Brady. Although found at only one station, it was very distinctive. There seem to be two variations:

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[5] Cushman, J. A., Carn. Inst. of Wash., Publ. 311 (1922), p. 5.

[6] Carn. Inst. of Wash., Papers from Dept. Marine Biology, 9 (1918): pl. 95.

[7] Cushman, J. A., An outline of a reclassification of the foraminifera. Contrib. Cushman Lab. Foram. Res., 3 (1927): pt. 1.

[8] Cushman, Foraminifera—their classification and economic use, Cushman Lab. Foram. Res., Spec. Publ. 1 (1928).

one, a smoothly finished form with generally horizontal constrictions at irregular intervals: the other a coarsely textured form in which the constrictions were much less prominent. Both variations were present in sample 11 in about equal amounts. They are both figured by Flint.[9] Another member of the same genus, *Rhabdammina linearis* Brady, was sparingly present in the same sample.

The Astrorhizidae appear to thrive best in depths between 500 and 1500 fathoms where the temperatures are about 2°–8° C, and are rarely met with above 200 fathoms. Cushman's report on the Atlantic Astrorhizidae,[10] as well as the data supplied by Flint,[11] also show that most members of this family exist in the deeper oceanic layers.

Family RHIZAMMINIDAE

One member of this family, *Rhizammina* sp. cf. *R. algaeformis,* was found in sample 5 at a depth of one fathom. However, the records of Flint[12] and Cushman[13, 14] show that certain species of this family occur between 100 and 2000 fathoms.

Family SACCAMMINIDAE

Four genera and seven species of this family were found in this study, all in sample 11, in 687 fathoms. *Saccamina sphaerica* Sars was also found in sample 9 in 60 fathoms. Forms belonging to this family are usually found in the deeper waters although there are several species rather common between 100 and 300 fathoms,[14] such as *Proteonina difflugiformis* (Brady).

Family HYPERAMMINIDAE

Two genera and three species of this family were studied. Their habitat is similar to that of the preceding family, all having been noted in sample 11.

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[9] Flint, J. M., U. S. Nat. Mus., Rept., 1897 (1899), pl. 13, coarse variation, fig. 1, smooth variation, figs. 2–5.

[10] Cushman, The foraminifera of the Atlantic Ocean, U. S. Nat. Mus., Bull. 104, pt. I (1918).

[11] Flint, *op. cit.*

[12] Flint, *op. cit.*

[13] Cushman, *op. cit.*

[14] Cushman, Recent foraminifera from the west coast of America, Bull. Scripps Inst. Oceanog., Tech. Ser. 1:130.

Family REOPHACIDAE

Many of the members of this family are also found in zones C and D. Two species, however, were noted at shallow depths: *Reophax scorpiurus* Montfort in 1 fathom and in 60 fathoms; and *R. nodulosus* Brady in 8 fathoms. Species of the genus *Reophax* are believed to have definite bathymetric distributions. In this study, *Haplostiche dubia* d'Orbigny was noted in sample 13, in 825 fathoms. Cushman[15] says that forms of this genus are characteristic of warm and rather shallow waters. Flint[16] finds *H. soldani* at depths of 210 and 196 fathoms in the Gulf of Mexico. The genus *Hormosina* is more characteristic of deep rather than shallow waters.

Family AMMODISCIDAE

Five genera and species of this family were noted, all occurring at stations 11, 12, and 13, in zone C, 500–825 fathoms. These five genera, *Ammodiscus, Glomospira, Lituotuba, Tolypammina,* and *Ammolagena,* are most commonly found in the cooler and deeper oceanic waters.

Family LITUOLIDAE

Five genera and twelve species of this family were noted. Only one of them, *Ammobaculites* sp., cf. *A. reophaciformis* Cushman, was found in shallow water. It appeared in small numbers in sample 4, in 2–3 fathoms and again in sample 7, in 8 fathoms. This same form is recorded by Cushman[17] in 7 and 11 fathoms, respectively, at Tortugas, Florida. This species appears to be limited to warm shallow waters.

The remaining members of this family which were studied all appeared in zones C and D, between 500 and 2500 fathoms. *Trochamminoides proteus* Karrer appeared at three stations from 504 fathoms to 2035 fathoms. Flint[18] records it at five stations from 400 to 1000 fathoms. It seems to be a deep-water form. Members of the genus *Haplophragmoides* were found at depths from 687 fathoms to 2035 fathoms. Seven species of this genus were noted at the former depth, the most common form being *H. subglobosum* (Sars). Specimens of

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[15] Cushman, Foraminifera—their classification and economic use, *op. cit.* (1928), 96.

[16] Flint, *op. cit.*, 277.

[17] Cushman, Carn. Inst. of Wash., Publ. 311 (1922), p. 5.

[18] Flint, *op. cit.*, 281.

this species were well preserved and generally measured over .5 mm. in diameter. The form *H. emaciatum* Brady appeared rather frequently at 687 fathoms. Members of the genera *Cribrostomoides* and *Cyclammina* live in a habitat generally similar to that of *Haplophragmoides.* Several large forms of *Cyclammina cancellata* Brady were found in sample 11.

As a whole, representatives of the *Lituolidae* are more common in the deeper and cooler oceanic layers, where the temperature range is from about 2° to 8° C. This is particularly true of certain species of the genera, *Trochamminoides, Haplophragmoides,* and *Cyclammina.*

FAMILY TEXTULARIIDAE

Four genera and twenty-seven species of this family were studied. Members of the Textulariidae are rather common in the shallow warm-water areas, from the beach to perhaps 60–100 fathoms. Several of them were also found in sample 13 at a depth of 825 fathoms, but the unusual conditions encountered at this point have already been commented upon (p. 333) in this report. Not including sample 13, only three representatives of this family were found at deeper than 60 fathoms: *Textularia milletti* Cushman, and a form referred to as *Bigenerina* sp. B, in 504 fathoms; and *Spiroplectammina biformis* (Parker and Jones) in 687 fathoms. All three of these were very rare, and were not found at any other stations.

Genus Textularia.—This genus seems to be generally confined to zones A and B, in shallow warm waters, where the temperature ranges from about 20° to 27° C. The most common form encountered was *T. agglutinans* d'Orbigny. It was found in seven samples, from the beach to a depth of 60 fathoms. It was particularly common in zone B, from 5 to 60 fathoms. *T. conica* d'Orbigny and *T. candeiana* d'Orbigny occupy about the same habitat and were also common down to 60 fathoms. Other forms generally confined to zone B include *T. floridana* Cushman, *T. gramen* d'Orbigny, and *T. mayori* Cushman. Seven more species of this genus were present in zone B in small numbers. Three forms, *T. milletti* Cushman, *T. porrecta* Brady, *T. concava* Karrer var. *heterostoma,* appeared only in the deeper zone C. The records published by Cushman[19] seem to bear out the fact that most members of this genus thrive best in shallow warm waters, and that there is a notable decrease in both individuals and numbers of species at depths greater than 200–300 fathoms.

[19] Cushman, U. S. Nat. Mus., Bull. 104, pt. III; also U. S. Nat. Mus., Bull. 100, 4, and U. S. Nat. Mus., Bull. 71, pt. II.

Genus Textulariella.—The form *T. barretti* Jones and Parker was noted in sample 9 at 60 fathoms. Like the *Textularia,* this genus usually appears at shallow depths, although Flint[20] records it off the Bahamas in 338 fathoms.

Genus Bigenerina.—The habitat of this genus closely resembles that of *Textularia. B. nodosaria* d'Orbigny, and its variety *textulariodea* Goës, were rather common in zone B. Two forms of questionable generic determination, *B.* sp. A, and *B.* sp. B, were found in zone C.

Family VERNEUILINIDAE

Three genera and sixteen species were found in this study. As a whole, this family does not seem to be restricted to any particular ecologic zone. Two of the genera studied here, *Verneuilina* and *Gaudryina,* were more common in the deeper waters, while *Clavulina* appeared more often in the shallow zones.

Genus Verneuilina.—Only one definite species was found. It appeared in three of the deeper samples, from depths of 687 to 2035 fathoms (and also possibly from 60 fathoms). Cushman[21] records 84 specimens of *V. bradyi* Cushman, from the Atlantic Ocean. All of these except one were found below 393 fathoms, and the largest proportion of the number, at depths greater than 1000 fathoms. The habitat of this species appears to be in zones C and D, between 500 and 2500 fathoms. One other unidentified species called *V.* sp. A was present in the beach sample no. 1 from the Bahamas.

Genus Gaudryina.—With one questionable exception, the six identified species of *Gaudryina* were all found in depths below 500 fathoms. *G. bradyi* Cushman appeared sparingly at four stations ranging from 504 to 2035 fathoms. *G. flinti* Cushman and *G. robusta* were both found in samples 11 and 13 in from 687 to 825 fathoms. In sample 11 both of these species were well represented. A form called *G.* sp. A was found in samples 10 and 13. The other three species noted were very rare, appearing in depths of 504 and 2035 fathoms. This genus seems to be more commonly met with in zones C and D, between 500 and 2000 fathoms, in temperatures from about 2° to 8° C.

Genus Clavulina.—*C. tricarinata* d'Orbigny seems to be commonly found in the shallow warm-water zone. It was found at six stations ranging in depth from the beach to 16 fathoms. A form referred to as *C.* sp. A appeared at two shallow-water stations. *C.* sp. cf. *C. parisiensis* d'Orbigny and *C. nodosaria* d'Orbigny were found in

[20] Flint, *op. cit.,* 285.

[21] Cushman, U. S. Nat. Mus., Bull. 104, pt. III, p. 60.

samples 6 and 9, respectively, while one isolated form of *C. nodosaria* var. *novangliae* was met with at the deeper bottom sample 84 (T.W.V.) in 825 fathoms. Representatives of this genus occurred more often in samples from the beach to 6 fathoms, than in the deeper zones C and D.

Family VALVULINIDAE

The species *V. oviedoiana* d'Orbigny, and what is perhaps a variety of it, were found only in very shallow depths. It appeared at four stations and was not found below one fathom in depth, being entirely restricted to zone A. At two of the stations it was very common, and at the other two it appeared rather frequently. In his Tortugas report, Cushman[22] records this species at 6 stations ranging in depth from beach to 5¾ fathoms. It seems to be fairly well confined to the shallow-water zone A, in temperatures between 21.5° and 31.4° C.

Family MILIOLIDAE

Eleven genera and one hundred and twenty-six species and varieties of this family were found in this study. The latter number includes over twenty-five undetermined species, which were designated by letter only. All of the nine samples examined between the beach and 60 fathoms showed large numbers of both individuals and species of this family. Five Atlantic samples from the beach to 5½ fathoms showed that 45 per cent of the total number of species and varieties present belonged to the Miliolidae.

The percentage of the species and varieties of the Miliolidae to the total species and varieties present in each of the samples is as follows:

Sample		Percentage of Miliolidae
1	Beach	38
2	Beach	53
3	1–1⅓ feet Murray Island (Pacific sample)	21
4	2–3 feet	43
5	1 fathom	60
6	5½ fathoms	41
7	8 fathoms	43
8	16 fathoms	33
9	60 fathoms	20
10	504 fathoms	14
11	687 fathoms	10
12	800–825 fathoms	17
13	825 fathoms	23
14	2035 fathoms	14
15	2849 fathoms	8

[22] Cushman, Carn. Inst. of Wash., Publ. 311, p. 16.

In the West Indian area, the Miliolidae thrive best down to about sixteen fathoms. Seven samples examined within this depth, showed that not less than one-third of the total species and varieties found, belonged to this family. With an increase in depth, there was a notable decrease both in the number of species and of individuals. Samples 12 and 13 (in 800–825 fathoms of water) show a slightly higher proportion of the Miliolidae than might be expected at these depths. This fact seems to be due to at least two causes: (1) the proximity of these stations to the Bahamas, and to the North American continent; (2) the presence of swift currents which are probably important factors in distributing the shallow-water fauna into the deeper channels.

The distance of the sample from a large land mass or a group of islands as well as conditions of temperature and depth may have a bearing on the abundance of the Miliolidae. Samples 10 and 14 varied greatly in depth, but the percentage of Miliolidae present was the same. In general, the most favorable habitat for members of the Miliolidae is in warm shallow waters of tropical and warm temperate seas in depths down to perhaps 50 to 60 fathoms, where the temperature ranges between 20° and 26° C.

Genus Quinqueloculina.—About forty species and varieties of this genus were identified. At least twelve of these forms were commonly met with in the samples down to 16 fathoms, and most of them down to 60 fathoms. They were rarely found outside of zones A and B. This list includes:

Q. agglutinans d'Orbigny
Q. bidentata d'Orbigny
Q. costata d'Orbigny
Q. poeyana d'Orbigny
Q. laevigata d'Orbigny
Q. candeiana d'Orbigny
Q. lamarckiana d'Orbigny
Q. polygona d'Orbigny
Q. dilitata d'Orbigny
Q. limbata d'Orbigny
Q. bradyana Cushman
Q. sp. cf. Q. samoaensis Cushman

The two arenaceous species, *Q. agglutinans* d'Orbigny and *Q. bidentata* d'Orbigny, were particularly characteristic in depths not greater than 16 fathoms. Cushman[23] records the former from twenty shallow-water stations at Tortugas.

The only members of this genus which were consistently found in the deeper waters were *Q. seminulum* (Linnaeus) and a form referred to as *Q. seminulum* var. They appeared at five stations, from 504 to 2849 fathoms. There are, however, many records of this species from shallow waters. One recent publication[24] cites the occurrence of this species in the San Francisco Bay region.

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[23] Cushman, Carn. Inst. of Wash., Publ. 311, p. 16.

[24] Hanna and Church, Recent foraminifera of San Francisco Bay, Calif. Jour. Pal., 1:200.

In general, the habitat of *Quinqueloculina* is in shallow tropical and warm temperate waters, but the genus is by no means confined to these depths.

Genus Schlumbergerina.—Only one member of this genus, *S. alveoliniformis* Brady, was met with in this study. It was found at three stations between the beach and 8 fathoms. Brady and Cushman have both found this species in shallow warm waters. The genus appears to be generally confined to zones A and B.

Genus Massilina.—Five species of this genus were encountered, but none of them were at all common. They were all found between the beach and 60 fathoms except a rare occurrence of *M. macilenta* Brady at a depth of 825 fathoms. The habitat of this genus seems to be similar to that of *Quinqueloculina.*

Genus Spiroloculina.—Twelve members of this genus were found. Only one of these, *S. depressa* d'Orbigny, appeared below 500 fathoms. All the others were detected only at stations between 5½ and 60 fathoms. This genus favors the shallow margins of temperate and tropical seas. It is rather common down to 500 or 600 fathoms but deeper than that it is rare. Brady[25] says that beyond 1000 fathoms only one form, *S. tenuissima* Reuss, is encountered with any frequency.

Genus Hauerina.—Cushman[26] states that this genus is apparently limited to the warmer portions of the Pacific. The three species met with in this study, *H. bradyi* Cushman, *H.* sp. cf. *H. fragilissima* (Brady), and *H. ornatissima* (Karrer) were generally found between 5½ and 16 fathoms.

Genus Sigmoilina.—This genus favors a deeper water habitat than most of the Miliolidae. Two species were found: *S. schlumbergeri* Silvestri at four stations from 60 to 825 fathoms, and *S. sigmoidea* (Brady) at two stations in depths of 687 and 825 fathoms, respectively. Both species seem to be well represented at moderate depths. Flint[27] records *S. sigmoidea* (Brady) in the West Indian area at depths between 680 and 1170 fathoms.

Genus Articulina.—Seven identified species of this genus were found. *Articulina* appears to be rather frequent in shallow warm water. *A. sagra* d'Orbigny was present at seven stations between the beach and 16 fathoms as well as in sample 13. The other six species of this genus found were also present down to 16 fathoms. The records of Flint and Cushman show, however, that members of this genus are often encountered in the deeper zones, and, like several other genera of this family, the genus is not confined to any definite bathymetric level.

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[25] Brady, H. B., Rept. Voy. of Chall., Zool. 9 (1884): 148.

[26] Cushman, U. S. Nat. Mus., Bull. 71, pt. VI, p. 62.

[27] Flint, U. S. Nat. Mus., Rept. for 1897 (1899): 302.

Genus Nubeculina.—One member of this genus, referred to *N. divaricata* var. *advena* Cushman, was present in sample 13 in 825 fathoms.

Genus Triloculina.—Nineteen identified species and varieties were found. In addition, five indeterminate forms were designated by letters. The habitat of this genus is generally similar to that of *Quinqueloculina*. The consistent appearance of about the same number of species of *Triloculina* in the shallow-water Atlantic samples down to 16 fathoms was very noticeable.

Sample	Depth	Number of species
1	Beach	11
2	Beach	10
4	2–3 feet	8
5	1 fathom	13
6	5½ fathoms	14
7	8 fathoms	15
8	16 fathoms	8

Two of the species of this genus were especially conspicuous because of their relative abundance in samples of almost any depth. *T. oblonga* (Montagu) was found in thirteen out of fifteen samples in depths down to 2849 fathoms. *T. circularis* Bornemann was detected in ten samples in depths down to 825 fathoms. Several species showed a marked tendency to live in the shallow waters only. These include *T. trigonula* (Lamarck), *T. carinata* d'Orbigny, *T. planciana* d'Orbigny, *T. linneiana* d'Orbigny, *T. labiosa* d'Orbigny, *T. rotunda* d'Orbigny, *T. quadrilateralis* d'Orbigny, and *T. fichteliana* d'Orbigny. The above eight species were found in at least five shallow-water samples down to 60 fathoms, but they are not confined to these depths.

Genus Flintina.—Three specimens of *F. bradyana* Cushman, as well as two other members of this genus, were present in beach sample 2. This was the only sample showing any species of *Flintina.*

Genus Pyrgo.—Several species of this genus were isolated. In this study, the members of the genus *Pyrgo* appeared about as frequently in the deeper zones as in the shallow warm waters. Two species, *P. subsphaerica* d'Orbigny and *P. denticulata* Brady var., were found at four shallow-water stations down to 60 fathoms. *P. depressa* d'Orbigny and *P.* sp. cf. *P. irregularis* d'Orbigny appeared in the cooler waters, the former at four stations from 60 to 825 fathoms, and the latter in five samples from 504 to 2035 fathoms. *P.* sp. A, which seems to be the biloculine variety of *Triloculina rotunda,* was encountered at six stations, from the beach down to 825 fathoms.

Flint[28] records eleven species and varieties of *Pyrgo* from the Atlantic samples. These specimens were found at 22 different stations ranging in depth from 26 to 1813 fathoms. Only six of these stations

[28] Flint, *op. cit.,* 293–295.

were at depths of less than 400 fathoms. Cushman[29] finds five species of this genus, at sixteen different Pacific stations. Only four of these stations were in depths less than 400 fathoms. In the two cases stated above, the data show that about three-quarters of the stations where members of the genus *Pyrgo* were encountered, were in waters of 400 fathoms or deeper. This tends to show that *Pyrgo* prefers a cooler habitat than most of the genera of the Miliolidae.

Family OPHTHALMIDIIDAE

Fifteen species and varieties, belonging to five (possibly six) genera of the family were studied. This family is not confined to definite temperatures or depth conditions, but certain of the genera favor the warm shallow zones.

Genus Cornuspira.—The form referred to *C. involvens* Reuss was found at four stations from the beach to 16 fathoms. It was also present in sample 13. At a depth of 5½ fathoms it was quite common. Two other species, *C. crassisepta* Brady and *C. lacunosa* Brady, were present between 687 and 825 fathoms. This genus seems to have a wide bathymetric distribution.

Genus Ophthalmidium.—A very questionable specimen from Albatross station 2751 in 687 fathoms was referred to this genus.

Genus Planispirina.—Two species of this genus were found. *P. auriculata* Egger occurred at four stations ranging in depth from beach to 16 fathoms. Cushman[30] had it at two stations in depth from 4¾ to 12 fathoms at Tortugas. Heron-Allen and Earland record it from the Kerimba Archipelago. It appears to be a shallow warm-water species. *P. sphaera* (d'Orbigny) was present in sample 11 in 687 fathoms. The records of Goës and Cushman show that this latter species is usually met with in deeper waters.

Genus Vertebralina.—Four species and varieties of this genus were studied. In general, they were more frequent in the shallow-water zones. *V. crassis* d'Orbigny and its variety *mucronata* d'Orbigny were found at four stations ranging in depth from the beach to 16 fathoms. The former also appeared in sample 13. *V. cassis* var. *mucronata* occurred in larger amounts than *V. casis.* Cushman[30] records this variety at seventeen shallow-water stations in the Tortugas. It is evidently rather common in the West Indies, the Gulf of Mexico, and on the Florida coast. Two other members of the genus occurred, viz., *V. striata* d'Orbigny in 8 fathoms and *V. insignis* Brady in 825 fathoms of water.

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[29] Cushman, Bull. Scripps Inst. Oceanog., Tech. Ser., 1:140–141.

[30] Cushman, Carn. Inst. of Wash., Publ. 311, p. 16.

Genus Nebecularia.—One species, *N.* sp. cf. *N. lucifuga* Defrance, was present in the beach sample from the Bahamas. The genus seems to have generally a shallow-water habitat.

Genus Silvestria.—The form *S. inflata* (Brady) was found sparingly at four stations ranging from beach to 825 fathoms. Brady, Rhumbler, and Cushman[31] record it from the beach to 40 fathoms. It appears to be a shallow-water type.

Family FISCHERINIDAE

Genus Fischerina.—One member of this genus, *F. dubia* d'Orbigny, was found at a depth of 5½ fathoms.

Family TROCHAMMINIDAE

Three genera and ten species of this family were encountered in this study. Members of this family are more apt to be found in the cool waters of zones C and D in temperatures of about 2°–4° C.

Genus Trochammina.—Two species, *T. advena* Cushman and *T. squamata* Jones and Parker, appeared at stations 4 and 11 in one-half fathom and 687 fathoms, respectively. The latter species is recorded by Cushman[32] in depths from 478 to 2369 fathoms in the Atlantic Ocean. It seems to have a wide bathymetric distribution. The other eight species of this genus were all found at depths below 500 fathoms. At least two of these, *T. globigeriniformis* Parker and Jones and *T. globulosa* Cushman, seem to be restricted to the deep waters. Cushman[33] found the former species at 28 stations, only two of which were above 600 fathoms.

Genus Globotextularia.—One member of this genus, *G.* sp. cf. *G. anceps* (Brady), appeared at stations 13 and 15 in 825 and 2849 fathoms, respectively. It is usually found in zones C and D.

Genus Ammochilostoma.—*A. pauciloculata* (Brady) was also found at station 10. Cushman reports this species from both the Atlantic and Pacific oceans. Two or three additional species of *Ammochilostoma* have been reported from deep-water stations. It seems to be generally restricted to depths greater than 500 fathoms.

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[31] Cushman, U. S. Nat. Mus., Bull. 71, pt. VI, p. 41.

[32] *Ibid.*, 104, pt. II, p. 72.

[33] *Ibid.*, 104, pt. II, p. 79.

Family LAGENIDAE

Ten genera and forty-six identified species of this family were found. Members of the Lagenidae seem to be more common in moderately deep oceanic layers than in shallow waters. Cushman[34] says that the best development of the family is in tropical regions at depths of 100–500 fathoms.

Genus Robulus.—Four forms are believed to belong to this genus. *R. calcar* (Linnaeus) was the most common of the four. It was found in three samples between 8 and 825 fathoms. The other three species were encountered between 60 and 825 fathoms.

Genus Lenticulina.—Species belonging to this genus were well represented in the samples between 60 and 825 fathoms. Nine different forms were identified in sample 9, at 60 fathoms. The most frequent species of the genus encountered was *L.* sp. *L. rotulata* Lamarck, which appeared in five of the samples between the limits mentioned above. *L. peregrina* Schwager was found at four stations at similar depths. *Lenticulina* and its allied genus *Robulus* are rarely met with in the shallow tropical regions. Cushman records only one species in his Tortugas report. The same author[35] states that these genera reach a great development, especially in number of species, in tropical waters from 100 to 500 fathoms in depth. In cold waters of similar depths, the species are not so numerous, although specimens are often abundant. Temperatures favorable for the development of these genera appear to be from about 5° to 21° C.

Genus Marginulina.—Three species were referred to this genus. They were found in depths from 60 to 825 fathoms. *Marginulina* favors a habitat similar to that of the two above-mentioned genera.

Genus Dentalina.—*D. communis* d'Orbigny appeared at three depths 60, 687, and 825 fathoms, respectively. *D. advena* Cushman was found in sample 11 in 687 fathoms.

Genus Nodosaria.—Six species and varieties of this genus were identified. They were found between 60 and 2849 fathoms. None of the species were common at any of the stations. The scarcity of both *Nodosaria* and its allied genus *Dentalina* at depths less than 60 fathoms is very noticeable. Only one form, which was referred to *N.* sp. *A*, appeared in this zone.

Genus Glandulina.—Two varieties of the species *G. laevigata* were found: *occidentalis* Cushman at station 10 in 504 fathoms, and *torrida* Cushman at station 13 in 825 fathoms.

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[34] *Ibid.*, 104, pt. IV, p. 3.

[35] *Ibid.*, 104, pt. IV, p. 101.

Genus Saracenaria.—*S. italica* Defrance and *S. acutamicularis* (Fichtel and Moll) appeared at station 9, in 60 fathoms.

Genus Vaginulina.—Two representatives of this genus were found. *V. linearis* (Montagu) was encountered at 16 and at 60 fathoms. At the latter depth it was rather common. *V. advena* Cushman was present in two samples, at 60 and 504 fathoms, respectively. Both *Vaginulina* and *Saracenaria* resemble *Lenticulina* in depth and temperature characteristics.

Genus Frondicularia.—Only one species, *F. sagittula* Van den Broeck, was found at station 9 in 60 fathoms. Cushman says that, at the present time, large typical species of *Frondicularia* are comparatively rare. There is a limited development of the genus in the warmer waters of the western Atlantic, and in the warmer and subtropical waters of the Pacific at depths of from 100 to 500 fathoms.

Genus Lagena.—Eighteen different forms were referred to this genus. With one exception, they were all found in depths from 687 to 2839 fathoms. One form, *L. squamosa* (Montagu), was present in sample 9 in 60 fathoms. None of the species occurred at more than one locality. According to Cushman, *Lagena* reaches a great development in certain shallow temperate waters like those around the British Isles. In other localities, it is found in greatest numbers from 1000 to 2000 fathoms. In this report, the favorable temperatures for *Lagena* seem to be from about 2° to 5° C.

Family POLYMORPHINIDAE

Three genera and ten species of this group were identified in this study. Nearly all of them were recorded from shallow waters. As a whole, this family has a wide bathymetric distribution in the Atlantic and Pacific oceans. However, some of the species seem to have definite ecologic value.

Genus Guttulina.—Three members of this genus, *G. communis* d'Orbigny, *G. problema* d'Orbigny, and *G. oblonga* d'Orbigny, appeared at depths between 8 and 60 fathoms. *G. spinosa* d'Orbigny was found at the deep-water station 15 in 2849 fathoms.

Genus Pyrulinella.—The type of this genus, *P. lanceolata* Reuss, was present in 2035 fathoms. *P. lactea* (Walker and Jacob), and its variety *novangliae* Cushman, appeared at three stations at from 5½ to 60 fathoms.

Genus Polymorphina.—Two species of *Polymorphina* were recognized at shallow depths, from 5½ to 16 fathoms.

Family NONIONIDAE

Several species belonging to the genera *Nonion* and *Elphidium* were isolated in this study.

Genus Nonion.—Six species of this genus were found. *N. scapha* appears to favor a shallow-water habitat. Of the five stations from which this form was reported, four were in 60 fathoms or less. The fifth was in sample 13 in 825 fathoms. *N. grateloupi* d'Orbigny was found rather frequently at three stations between 5½ and 16 fathoms. Cushman[36] records *N. grateloupi* at fourteen shallow-water stations between the beach and 18 fathoms at Tortugas. *N. depressula* (Walker and Jacob) and *N. umbilicatula* (Montagu) each appeared at three stations, and both seem to have a wide bathymetric range. From Cushman's data,[37] as well as the results of this report, *N. pompilioides* (Fichtel and Moll) appears to favor the deeper waters. It was found at the two deepest stations in depths ranging from 2035 to 2839 fathoms. As a whole, this genus is not restricted to definite bathymetric zones, although it is much more common in the deep cool waters than is its ally *Elphidium.*

Genus Elphidium.—The eight identified species of this genus found in the sediments studied were all warm, shallow-water types. *E. poeyana* d'Orbigny, and the closely related *E. striatopunctata* (Fichtel and Moll), were the most commonly met with. The former appeared at seven shallow-water stations in depths down to 60 fathoms. It was also found in sample 13. The latter species was present at four stations from the beach to 5½ fathoms. The distinction between the two species, however, was not entirely clear, in the material studied. *E. macella* (Fichtel and Moll), *E. advena* Cushman, and *E. discoidalis* (d'Orbigny) were all found in depths down to 16 fathoms. The latter species was rather common in sample 7 in 8 fathoms. Two species, *E. craticulata* (Fichtel and Moll) and *E. milletti* Heron-Allen and Earland, were found only at the Pacific station at Murray Island. The former was very common in this sample. Cushman[38] considers this form "distinctly a tropical shallow-water species." A specimen called *E.* sp. *E.* was present at four stations between the beach and 8 fathoms. *Elphidium* seems to be a rather common genus in warm shallow waters, and several of its species are probably rather closely confined to these limits.

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[36] Cushman, Carn. Inst. of Wash., Publ. 311.

[37] *Idem,* U. S. Nat. Mus., Bull. 71, pt. IV, p. 25.

[38] *Ibid.,* p. 34.

Family CAMERINIDAE

Only two representatives of this family were found. They both appeared in warm shallow waters.

Genus Heterostegina.—This genus[39] is characteristic of the shallow water of the tropics. *H. antillarum* d'Orbigny appeared at three stations in depths down to 8 fathoms. Several specimens of *H. suborbicularis* d'Orbigny were present at the Murray Island station in one foot of water. *Heterostegina* seems to thrive in temperatures from about 22° C to 27° C and in depths down to perhaps 40 fathoms.

Family PENEROPLIDAE

Seven genera and fourteen species of this family were found. Members of the Peneroplidae are almost never found below 60 fathoms and are restricted[40] to warm, shallow-water zones. In the West Indian region, and off the coast of Florida, a large proportion of the beach deposits are made up of species of *Peneroplis* and *Archaias.*

Genus Peneroplis.—Seven species of this genus were present. Four of these, *P. pertusus* Forskål, *P. arietinus* (Batsch), *P. discoideus* Flint, and *P. proteus* d'Orbigny, appeared very consistently in the samples down to 16 fathoms. *P. proteus* was very common and even abundant in three of these samples. This genus is closely restricted to the shallow warm waters and favors temperatures between 22° and 30° C.

Genus Spirolina.—One member of this genus was found in two of the samples, no. 1, on the beach, and no. 8, in 16 fathoms. The genus is closely related to *Peneroplis.*

Genus Monalysidium.—Two specimens of the form *M. polita* Chapman? were encountered at 5½ and 8 fathoms. The genus has been found only in recent material.

Genus Archaias.—This genus is often extremely common in the warm shallow waters of the West Indian and Florida regions. *A. adunca* (Fichtel and Moll) was found at eight stations ranging from the beach to 60 fathoms. At two of these, in depths of 1 and 5½ fathoms, respectively, it was very abundant. *A. compressa* d'Orbigny was found at three stations down to 8 fathoms. The habitat of this genus is very close to that of *Peneroplis.*

Genus Sorites.—One representative of this genus, *S. marginalis* Lamarck, appeared at four shallow-water stations down to 60 fathoms, and at station 13 in 825 fathoms.

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[39] *Ibid.*, p. 38. [40] Cushman, Cushman Lab. Foram. Res., Spec. Publ. 1, p. 223.

Genus Amphisorus.—*A. duplex* Carpenter was found in seven shallow-water samples down to 16 fathoms. This species is commonly met with in the warm waters of the West Indian area.

Genus Marginopora?.—A few specimens of a form referred to as *M. vertebralis* Quoy and Gaimard were found at the Murray Island station.

Family ALVEOLINELLIDAE

Genus Borelis.—One member of this genus, *B. pulchra* d'Orbigny, was present at six shallow-water stations down to depths of 8 fathoms. Cushman[41] records it from two Tortugas stations, and it has been found from the north coast of Jamaica and from Cuba. The species appears to have a tropical, shallow-water habitat.

Family HETEROHELICIDAE

Genus Bolivinita.—*B. rhomboidalis* (Millett) was found at two stations down to 5½ fathoms. It seems to be present only in warm shallow waters.[42]

Family BULIMINIDAE

Ten genera comprising 44 species and varieties of this family were found. As a whole, the Buliminidae have a wide bathymetric range, and are not restricted as regards conditions of depth and temperature.

Genus Buliminella.—Three representatives of this genus were reported. One of these, *B. elegantissima* var. *seminuda* (Terquem), was encountered in sample 1 on the beach. *B. subteres* (Brady) appeared in samples 9, 10, and 11, 60 to 687 fathoms in depth. A form called *B.* sp. *A.* was found at station 13. Five species and varieties of *Buliminella* were listed by Cushman[43] from the Atlantic Ocean. He found 38 specimens, only one of which occurred above 100 fathoms, and 29 of them below 500 fathoms. The genus seems to be more or less confined to deep cool waters in temperatures from about 2° to 8° C.

Genus Bulimina.—Seven species and varieties of this genus were studied. With the exception of *B. marginata* Cushman and *B. ovata* d'Orbigny, both of which occurred in sample 9 in 60 fathoms, the other members were found in zone C (500 to 825 fathoms). *B. inflata* Sequenza was met with at three stations in zone C. Cushman[44] records 189 specimens of this species from 38 stations in the Atlantic. Only

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[41] Cushman, Carn. Inst. of Wash., Publ. 311, p. 17.

[42] *Idem*, U. S. Nat. Mus., Bull. 104, p. 44.

[43] *Ibid.*, pt. III, pp. 108–113. [44] *Ibid.*, p. 94.

three of these stations are in depths less than 500 fathoms. Three specimens of *B. inflata* var. *mexicana* Cushman were encountered in sample 10 in 504 fathoms. *B. aculeata* d'Orbigny and *B.* sp. cf. *B. pyrula* d'Orbigny were found in sample 11, and *B. buchiana* d'Orbigny appeared in sample 13. Members of this genus seem to occur rather often in the deeper regions of the ocean, but usually in small numbers.

Genus Virgulina.—Only three species of *Virgulina* were found. *V. punctata* d'Orbigny appeared at three stations in depths from 5½ to 16 fathoms. It was very common at station 6 in 5½ fathoms. Cushman records it from thirteen stations in the Tortugas region in depths down to 18 fathoms, and says[45] "it is probably widely distributed in the Gulf of Mexico and the Caribbean regions in similar habitats." One specimen of *V.* sp. cf. *V. subdepressa* Brady was found in the Murray Island sample. The other species, *V. schreibersiana* Czjzek, was found in samples 11 and 15 in 687 and 2849 fathoms, respectively.

Genus Bolivina.—Thirteen species and varieties of this genus were studied in this report. Wherever found, the members of *Bolivina* seem to occur sparingly or very rarely. They are nearly all very small forms, generally less than 1 mm. and very often as small as .1 to .2 mm. At Bird Key Harbor, in 5½ fathoms of water, five different species of *Bolivina* were found. Of these five species, *B. pulchella* (d'Orbigny) occurred at three other localities, two of which were in shallow water and the other in 504 fathoms. Isolated members of this genus appearing in the shallow-water zones are *B. tortuosa* Brady, *B. limbata* var. *costulata* Cushman, *B. dilatata* Reuss, *B. subaenariensis* Cushman, *B.* sp. cf. *B. porrecta* Brady, *B.* sp. cf. *B. inflata* Heron-Allen and Earland, and *B. compacta* Sidebottom. Four forms: *B. albatrossi* Cushman, *B.* sp. cf. *B. beyrichi* Reuss, *B. robusta* Brady, and *B. goësii* Cushman, were extremely rare in the deeper zone C.

Cushman[46] states that "the species of this genus for the most part seem to be very local in their distribution." This fact appears to be borne out in this report, for out of a total of fifteen different forms, only three were found at more than one locality, and only one, *B. pulchella,* at more than two stations.

Genus Loxostomum.—The form, *L. mayori* Cushman, was present at one shallow-water station in 5½ fathoms of water.

Genus Reussia.—Information on this genus is restricted to the form *R. spinulosa* (Reuss), and its variety *glabrata* Cushman. The species was found at four stations ranging from 5½ to 60 fathoms.

[45] Cushman, Carn. Inst. of Wash., Publ. 311, p. 32.

[46] *Idem,* U. S. Nat. Mus., Bull. 104, pt. III, p. 29.

Cushman[47] records 25 specimens of this species from depths between 20 and 168 fathoms. It seems to be generally restricted to the shallow waters.

Genus Uvigerina.—Thirteen species and varieties of *Uvigerina* were noted. None of these were found in depths less than 60 fathoms. *U. auberiana* d'Orbigny, with two of its varieties, was present at depths ranging from 504 to 2035 fathoms. *U. peregrina* Cushman, with one of its varieties, appeared between 687 and 825 fathoms; while two more of its varieties, *parvula* Cushman and *bradyana* Cushman, were detected at b.s. 100 in 60 fathoms. Several specimens of *U. flinti* Cushman were obtained between 60 and 825 fathoms. A few other species of *Uvigerina* appeared but were very rare. The genus seems to favor a deep-water habitat, and its absence in the eight shallow-water stations is significant. Cushman[48] believes that species of this genus have a definite distribution in the western Atlantic.

Genus Siphogenerina.—Only one species, *S. advena* Cushman, was found. It was detected in samples 6 and 7 in 5½ and 8 fathoms, respectively. Cushman[49] states that this genus is best developed in tropical waters below 500 fathoms.

Genus Angulogerina.—*A. angulosa* Williamson was present at station 6 in 5½ fathoms. It is recorded at 26 stations in the Atlantic, at depths from 60 to 1813 fathoms, although most of the specimens appeared in less than 800 fathoms of water. Cushman[50] found it at two shallow-water Tortugas stations.

Genus Trifarina.—The type species of this genus, *T. bradyi* Cushman, was found in sample 10 in 504 fathoms. Nineteen specimens of this form are recorded from the Atlantic material between 56 and 683 fathoms. Of these, seventeen were from depths of 168 fathoms or lower.

Family ROTALIIDAE

Ten genera and thirty-seven species of this family were found. A few of the genera of the Rotaliidae seem to possess definite ecologic value. *Rotalia* and perhaps *Discorbis* are shallow-water groups. *Gyroidina* is indicative of deep waters. Additional data may show that other members of the genera have definite bathymetric distributions.

Genus Spirillina.—*S. vivipara* Ehrenberg was detected at six stations down to 16 fathoms in depth. One specimen occurred in sample 13 in 825 fathoms. A variety of the same species was found in three samples from 5½ to 16 fathoms. Both of these forms seem to be best

[47] *Ibid.*, p. 61.
[48] *Ibid.*, p. 161.
[49] *Ibid.*, p. 173.
[50] *Idem*, Carn. Inst. of Wash., Publ. 311, p. 16.

developed in shallow warm waters in temperatures from about 80° to 70° F. Another form called *S.* sp. *A.* was collected at the Murray Island station. *S. decorata* Brady was present at Albatross station 2660 in 504 fathoms. Brady[51] states that this species is more often found in deeper waters than are the other known members of this genus.

Genus Discorbis.—Of the twenty-two recognized different forms of this genus, seventeen occurred in shallow waters down to 60 fathoms. Six representatives of *Discorbis* appeared in sample 13 in 825 fathoms. The peculiar conditions at this station have been commented upon earlier (p. 333). *D. mira* Cushman and *D. candeiana* d'Orbigny were detected in seven samples ranging from the beach to 60 fathoms. These two species may be rather closely confined to shallow waters. Cushman[52] records them both from the Tortugas. *D. orbicularis* (Terquem) and *D. bertheloti* d'Orbigny were frequently met with between the beach and 60 fathoms. Species of this genus seem to thrive best in rather shallow water, and several of them have a rather definite bathymetric distribution.

Genus Lamarckina.—I have referred one specimen to this genus as *L.* sp. *A.* It conforms fairly well with the description of *Lamarckina* as given in a recent publication. Other members of the genus are known in the recent oceans, *i.e., L. scabra* (Brady).[53]

Genus Valvulinera.—A form called *V. vilardeboana* (d'Orbigny) and one of its varieties was frequently met with between the beach and 60 fathoms.

Genus Gyroidina.—Two members of this genus were noted. *G. soldanii* d'Orbigny was found at five stations from 60 to 2849 fathoms. It appears to have a wide bathymetric distribution.[54] *G. broeckhiana* Karrer appeared at four deep-water stations from 504 to 825 fathoms. Records of the genus *Gyroidina* in shallow waters are rare.

Genus Eponides.—Six species belonging to this genus were identified. Two species were present only in shallow water: *E. repanda* (Fichtel and Moll) at five shallow-water stations down to 60 fathoms; and *E. incerta* Cushman at stations 8 and 9 in 16 and 60 fathoms, respectively. *E. umbonata* Reuss was rather common in the deep zones. It was found in five samples from 504 to 2849 fathoms. This form also appeared at the Murray Island station. *E. pygmea* Hantken was present in three samples from 825 to 2849 fathoms. A form referred to *E.* sp. cf. *E. hauerii* Reuss appeared at two stations in 2035 and 2849 fathoms, respectively. As a whole, the genus is not restricted

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51 Brady, *op. cit.*, 630. 52 Cushman, Carn. Inst. of Wash., Publ. 311, p. 7.
53 Brady, *op. cit.*, 689, pl. 106, fig. 8.
54 Cushman, U. S. Nat. Mus., Bull. 71, pt. V, p. 71.

to definite bathymetric levels, but several of the species are undoubtedly very rare in shallow waters, e.g., *E. pygmea.*

Genus Rotalia.—Three members of this genus were identified. *R. rosea* d'Orbigny was present at four shallow-water stations down to 8 fathoms. It was also noted in sample 13. At two of the shallow-water stations it was extremely common. This little form is often found in very shallow warm waters. A form referred to *R. beccarii* (Linnaeus) appeared at four shallow-water stations down to 16 fathoms. In the Murray Island sample, *R. calcar* d'Orbigny was present in enormous numbers. Members of this genus seem to have definite ecologic relations, and are practically confined to shallow warm waters.

Genus Epistomina.—One species, *E. elegans,* was found in sample 11 in 687 fathoms. Its habitat is generally the deep cool waters.[55]

Genus Siphonina.—Cushman[56] records ten localities of *S. pulchra* Cushman from the shallow waters of the Tortugas. I have found it in seven samples ranging from less than 1 fathom to 825 fathoms. In sample 13 it was very common, while in three samples, 7, 8, and 9, ranging in depth from 8 to 60 fathoms, it was frequently met with. The form *S. reticulata* (Czjzek), although appearing to grade into the preceding form, was found at two stations in 60 and 825 fathoms, respectively.

Genus Cancris.—One species, *C. semipunctata* Cushman, was noted at two stations in 5½ and 60 fathoms, respectively.

Family AMPHISTEGINIDAE

Genus Asterigerina.—A. carinata d'Orbigny is very abundant in the shallow warm waters of the West Indian region. D'Orbigny described this species from the beach sands of Cuba and Jamaica. Cushman[57] found it at all twenty-one Tortugas stations in depths from the beach to 18 fathoms. At all these stations it was extremely abundant or very common. I found it at six shallow-water stations down to 60 fathoms. It was also present in sample 13. It appears to be very abundant[58] in comparatively shallow water in the region of the West Indies and Florida extending north as far as Cape Hatteras.

Genus Amphistegina.—A lessoni d'Orbigny was detected at seven stations ranging in depths from the beach to 60 fathoms. A few specimens of this species were also found in sample 13. It is often found in shallow tropical waters. Two forms, *A.* sp. cf. *A. madagascarensis* d'Orbigny and *A.* sp. *A.*, were separated out, but they may be merely variations of *A. lessoni.*

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[55] *Ibid.*, 63.
[56] Carn. Inst. of Wash., Publ. 311, p. 16.
[57] *Ibid.*
[58] Cushman, U. S. Nat. Mus., Bull. 59, p. 60.

Family CALCARINIDAE

Genus Calcarina.—*C. spengleri* (Linnaeus) and possibly *C. hispida* Brady were common at the Murray Island station. As recorded by Cushman[59] both species are generally found in the shallow waters of the Pacific region.

Genus Baculogypsina.—*B. sphaerulatus* Parker and Jones was very abundant in sample 3 near Murray Island. It is a common shallow-water form in certain Pacific areas.

Species of both the above genera thrive best in the shallow tropical waters of the Indo-Pacific region.

Family CYMBALOPORETTIDAE

Genus Cymbaloporetta.—The pelagic form, *C. squammosa* d'Orbigny, and its variety *bradyi* Cushman, appeared at eight stations ranging in depth from the beach to 825 fathoms. However, the majority of the specimens came from shallow depths between the beach and 8 fathoms.

Genus Tretomphalus.—One specimen of *T. milletti* Heron-Allen and Earland was found at 5½ fathoms. A questionable *T. bulloides* d'Orbigny occurred at 504 fathoms.

Family CASSIDULINIDAE

Five genera and eleven identified species and varieties of this family were found. Only two species of this group were found in depths less than 60 fathoms.

Genus Ceratobulimina.—The form *C. contraria* Reuss appeared at two stations: no. 10 in 504 fathoms and no. 15 in 2849 fathoms. This species has been noted by several authors at various depths below 100 fathoms.

Genus Pulvinulinella.—*P. culter* (Parker and Jones) was found at four stations from 504 to 825 fathoms. *P. exigua* Brady was identified at three stations from 504 to 2849 fathoms.

Genus Cassidulina.—This genus seems to be rather widely distributed both geographically and bathymetrically. *C. subglobosa* Brady was most frequently encountered. It was found at six stations ranging in depth from 60 to 2035 fathoms, but it seemed to be most common at depths between 504 and 825 fathoms. *C. crassa* d'Orbigny

[59] Cushman, U. S. Nat. Mus., Bull. 100, 4:352, 356, 363.

appeared in samples 6, 9, 10, and 13, in depths from 5½ to 825 fathoms. Another form called *C.* sp. *A.* was found in deep-water samples 12 and 13. Isolated specimens of *C. braziliensis* Cushman and *C. favus* (Brady) were encountered, the former in 60 fathoms and the latter in 2035 fathoms.

Genus Cassidulinoides.—An isolated specimen of *C. parkeriana* (Brady) appeared at the shallow-water Murray Island station.

Genus Ehrenbergina.—Cushman[60] states that the habitat of this genus in the Atlantic area is confined to the region south of Cape Hatteras to the Caribbean Sea and the coast of South America. Only three members were found in this study: *E. trigona* Goës and *E.* sp. cf. *E. trigona* var. *braziliensis* Cushman, in single specimens at depths of 800–825 fathoms, and *E.* sp. cf. *E. pupa* (d'Orbigny) in 687 fathoms.

Family CHILOSTOMELLIDAE

Genus Pullenia.—Two species were found. *P. quinqueloba* (Reuss) at five stations from 504 to 2849 fathoms and *P. sphaeroides* (d'Orbigny) at an equal number of stations in depths from 60 to 825 fathoms. Both species are often met with in the deeper oceanic layers, but usually in small amounts.

Genus Sphaeroidina.—*S. bulloides* d'Orbigny occurred at six stations but was rare except in sample 11 in 687 fathoms. It was found in depths ranging from 504 to 2849 fathoms, and possibly at locality 9 in 60 fathoms.

Species of these two genera favor a habitat in the cool waters and are generally found below 500 fathoms.

Family GLOBIGERINIDAE

Members of this family were extremely abundant in the sediments studied between 504 and 2849 fathoms. The genera are composed of pelagic species, which occur in vast numbers at the surface in the warm seas. Ocean currents carry them in all directions, but there is a marked decrease in numbers of the Globigerinidae in the cold regions. Brady[61] states that "over large areas they exist in a profusion far outweighing in aggregate all other organisms." An abundance of members of this family is a good indication of open-sea conditions although isolated specimens may be recovered at almost any depth.

Genus Globigerina.—Six species belonging to this genus were identified. One species called *G.* sp. *A.* can be referred to the monstrous,

[60] Cushman, U. S. Nat. Mus., Bull. 104, pt. III, p. 133.

[61] Brady, *op. cit.*, 593.

wild-growing forms figured by Brady.[62] It may be the same as *G. glomerata* Ehrenberg?.[63] Only scattered specimens of this genus appeared in samples under 60 fathoms. Below 500 fathoms *G. bulloides* d'Orbigny, *G. rubra* d'Orbigny, and *G. dubia* Egger appeared with regularity and were usually common to abundant in each sample. The latter was particularly abundant between depths of 687 and 825 fathoms. The other three identified species were not common and were present in only a few samples.

Genus Globigerinoides.—Two species, *G. sacculifera* (Brady) and *G. conglobata* (Brady), were found in each of the seven samples between 60 and 2849 fathoms. They were generally common in each of these samples. The former species was also detected at station 1, on the beach. *G. rubra* d'Orbigny appeared at eight stations between 5½ and 2849 fathoms. It was very abundant at station 9 in 60 fathoms. The rare form *G. helicina* d'Orbigny was found in 687 fathoms. The distribution of this genus is similar to that of *Globigerina*.

Genus Globigerinella.—The species *G. aequilateralis* (Brady) was present in seven samples between 60 and 2849 fathoms. A form referred to *G.* sp. cf. *G. digitata* (d'Orbigny) was found at station 11 in 687 fathoms.

Genus Hastigerina.—Only a single specimen of *H. pelagica* (d'Orbigny) appeared in this study. It was found at Albatross station 2751 in 687 fathoms.

Genus Orbulina.—*O. universa* d'Orbigny appeared at similar bathymetric levels and was generally associated with certain other pelagic forms such as *Globigerina dubia* Egger and *Globigerinoides sacculifera* (Brady). It was found from 60 to 2849 fathoms and was very common between 504 and 825 fathoms. Two specimens of *O. perosa* (Terquem) were recovered at depths of 687 and 825 fathoms. A form called *O.* sp. A. was found at four stations ranging in depth from 60 to 825 fathoms. It is figured by Brady under *O. universa* d'Orbigny and called by Bagg, *Globigerina bilobata* d'Orbigny.[64]

Genus Pulleniatina.—The species *P. obliquiloculata* (Parker and Jones) was present at seven stations from 60 to 2849 fathoms. It was very abundant at 504 fathoms and common at depths of 687 and 825 fathoms. In the Atlantic area, Cushman[65] records this species at 105 stations, ranging in depth from 23 to 2949 fathoms. Most of these stations were below 500 fathoms.

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[62] *Ibid.*, pl. 81, figs. 6 and 7.

[63] *Ibid.*, 593.

[64] Bagg, R. M., Miocene foraminifera from California, p. 42, pl. 7, fig. 8.

[65] Cushman, Foraminifera of the Atlantic Ocean, pt. V, p. 44.

Genus Sphaeroidinella.—*S. dehiscens* (Parker and Jones) was also found at seven stations in depths from 60 to 2849 fathoms. A few specimens were noted in sample 6 in 5½ fathoms. The habitat of this species parallels closely that of *P. obliquiloculata.*

Genus Candeina.—*C. nitida* d'Orbigny appeared in two samples. It was rare at Albatross station 2660 in 504 fathoms, while about a dozen specimens were found in sample 11 in 687 fathoms.

Family GLOBOROTALIIDAE

Genus Globorotalia.—Seven pelagic species belonging to this genus were present. *G. tumida* (Brady) and *G. menardii* (d'Orbigny) were found between 16 and 2849 fathoms. The former was very abundant at depths of 687 and 2935 fathoms, while the latter was very abundant at stations 10 and 11 in 504 and 687 fathoms. *G. menardii* appeared rarely in two very shallow samples. *G. truncatulinoides* d'Orbigny was rather commonly met with in the samples from below 500 fathoms. *G. crassa* (d'Orbigny) was noted at seven stations from 5½ to 2849 fathoms. Three other species of this genus were found below 500 fathoms.

Family ANOMALINIDAE

Genus Anomalina.—Seven species belonging to this genus were found. Several of them seem to have a wide temperature and depth range: *A. grosserugosa* (Gümbel) appeared in six samples ranging in depth down to 825 fathoms; *A. ammonoides* (Reuss) at six stations down to 687 fathoms; *A. coronata* Parker and Jones in four samples down to 825 fathoms; and *A. polymorpha* Costa in three samples down to 504 fathoms. *A. edwardsiana* d'Orbigny appears to favor a shallow-water habitat. D'Orbigny described the form from the sands of Cuba and Jamaica. Cushman[66] records it at five shallow-water Tortugas stations. I found it in four samples ranging from the beach to 60 fathoms.

Genus Planulina.—The type species, *P. ariminensis* d'Orbigny, is usually present in deep water. Cushman and Bagg[67] report it at four stations from 786 to 1544 fathoms. I have it from three samples, at depths of 60, 504, and 825 fathoms, respectively.

Genus Laticarinina.—The peculiar form, *L. pauperata* (Parker and Jones), was found at three deep-water stations in 504, 687, and 825 fathoms. It seems to favor a deep-water habitat. Brady, Goës, and Flint record it at five Pacific stations in depths from 770 to 1850

[66] *Idem,* Carn. Inst. of Wash., Bull. 311, p. 16.

[67] *Idem,* U. S. Nat. Mus., Bull. 71, pt. V, p. 44.

fathoms. Flint[68] also had it at two stations in the Gulf of Mexico in 347 and 730 fathoms. Cushman[69] found it at several Pacific stations at depths ranging from 1029 to 2278 fathoms.

Genus Cibicides.—Seventeen species and varieties were referred to this genus. There were also nine indeterminate forms which probably belong to *Cibicides.* In general, species of this genus have a wide bathymetric distribution and are found from the beach to the deepest areas. However, both the numbers of species and individuals seem to be more common below 100 fathoms than above that depth.

Two forms, *C. advena* d'Orbigny and *C.* sp. cf. *C. cora* d'Orbigny, appeared rather consistently in shallow water, the former at seven stations from the beach to 60 fathoms, as well as in sample 13, and the latter at five stations from the beach to 16 fathoms. Several species were not found at depths less than 500 fathoms in the material studied for this report, although there are many records of their occurrence in shallow water. This list includes *C. akneriana* d'Orbigny, *C.* sp. cf. *C. tenera* Brady, *C. haidingeri* d'Orbigny, *C.* sp. cf. *C. praecincta* Karrer, and *C. dutemplei* d'Orbigny. The form, *C. wuellerstorfi* Schwager, was found in seven samples from 8 to 2035 fathoms, but it was common at three stations below 500 fathoms. *C. ungeriana* d'Orbigny and *C. lobatula* (Walker and Jacob) were present in several samples and have a wide bathymetric range.

Genus Cibicidella.—A form referred to *C.* sp. cf. *C. variabilis* (d'Orbigny) appeared at Murray Island station at a depth of one fathom.

Family PLANORBULINIDAE

Genus Planorbulina.—This genus is most often present in the shallow-water margins of temperate and tropical seas. Brady[70] states that below 100 fathoms it is rarely found. *P. acervalis* Brady occurred in five samples between the beach and 16 fathoms. Several specimens were noted at depths of 5½ and 8 fathoms. An isolated specimen of *P. mediterraneansis* d'Orbigny appeared at sample 9 in 60 fathoms.

Genus Planorbulinella.—A single specimen of *P. larvata* (Parker and Jones) was noted at station 7 in 8 fathoms.

Genus Gypsina.—*G. globulus* (Reuss) was found at three stations in ½, 8, and 60 fathoms. Cushman[71] records thirteen specimens from the Philippine region. Twelve of these were at depths of less than 80 fathoms.

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[68] Flint, *op. cit.*, 330.

[69] Cushman, U. S. Nat. Mus., Bull. 71, pt. V, p. 61.

[70] Brady, *op. cit.*, 656.

[71] Cushman, U. S. Nat. Mus., Bull. 100, 4:352, 356, 363.

Family RUPERTIIDAE

Genus Rupertia.—A questionable species of *Rupertia* appeared at Albatross station 2751 in 687 fathoms.

Genus Carpenteria.—Only one specific form of this genus was identified, *C. proteiformis* Goës. It occurred in sample 13 in 825 fathoms. Cushman[72] states that it is essentially a coral reef species. In the Philippine region, the same author recorded 99 specimens, 80 per cent of which were at 100 fathoms or above.

Family HOMOTREMIDAE

Genus Homotrema.—*H. rubrum* (Lamarck) seems to be confined to shallow warm-water areas. It was found at three stations from the beach to one fathom.

Genus Polytrema.—*P. miniaceum* (Pallas) attached to corals was very common at the Murray Island station. It appears to be found in the shallow tropical waters of the Pacific.

SUMMARY OF RESULTS

To show the relationship of the families at different depths, several tables were compiled.

Table 1 shows the number of families and genera, and the total number of different species, varieties, and indeterminate species, at each of the fifteen stations. *g,* number of genera present in each sample. *t,* total number of species, varieties, and indeterminate species present in each sample.

Table 2 shows the percentage of different species, varieties, and indeterminate species belonging to each family, in relation to the total number of different species, varieties, and indeterminate species in each sample.

Figure 1 is a graphic interpretation of this table.

Table 3 shows the percentage of different species, varieties and indeterminate species belonging to each family, in relation to the total number of different species, varieties, and indeterminate species in zone A (0–5 fathoms), zone B (5–60 fathoms), zone C (500–825 fathoms), and zone D (2000–2849 fathoms).

Figure 2 is a graphic interpretation of table 3.

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[72] *Ibid.,* 71, pt. V, p. 49.

Family																												
	g	t	g	t	g	t	g	t	g	t	g	t	g	t	g	t	g	t	g	t	g	t	g	t	g	t	g	t
Astrorhizidae																					2	4			1	1		
Rhizamminidae							1	1																				
Saccamminidae																	1	1			4	7						
Hyperamminidae																					2	3			1	1		
Reophacidae					1	1							1	1			1	1			3	6			2	2		
Ammodiscidae																					3	3	2	2	1	1		
Lituolidae							1	1					1	1					1	1	4	11	1	2	2	3	2	2
Textulariidae	2	3			1	5	1	1			2	4	2	6	3	10	3	14	2	2	1	1			2	13		
Verneuilinidae	2	2	1	2	1	2					1	3	1	1	1	1	3	3	2	5	2	4			3	7	2	2
Valvulinidae	1	1	1	2			1	1	1	2															1	1		
Miliolidae	6	36	5	34	5	11	4	26	4	32	8	61	8	58	7	36	6	26	5	12	4	12	3	9	8	46	2	7
Ophthalmidiidae	3	4	2	2	2	2					4	5	3	6	3	4					3	3	1	1	3	5		
Fischerinidae											1	1																
Trochamminidae							1	1					1	1					2	2	1	2	1	2	2	5		
Lagenidae													2	2	2	2	9	21	5	6	5	11	2	3	7	16	1	5
Polymorphinidae	2	2									2	3	2	2	3	7	2	2									1	1
Nonionidae	2	7	2	5	1	2	2	5	2	5	2	8	2	6	2	6	2	4	1	1			1	1	2	6	1	1
Camerinidae					1	2	1	1					1	1														
Peneroplidae	4	11	3	7	3	6	3	5	2	5	5	11	5	9	5	10	3	3					1	1	3	7		
Alveolinellidae	1	1			1	1	1	1			1	1	1	1	1	1												
Heterohelicidae	1	1									1	1																
Buliminidae	2	2			2	3					6	9	4	6	3	3	5	12	5	7	5	8	2	2	6	14	1	2
Rotaliidae	3	8	2	9	5	6	3	4	2	6	8	18	6	16	5	12	5	10	5	6	2	2	2	4	7	15	2	5
Amphisteginidae	2	2			1	1	2	2			2	2	2	2	2	2	2	2							2	4		
Calcarinidae					2	2																						
Cymbaloporettidae	1	1			1	1	1	1	1	1	2	3	1	1					1	1			1	1	1	2		
Cassidulinidae					1	1					1	1					1	3	3	5	3	3	3	4	3	5	2	3
Chilostomellidae															1	1	1	1	2	3	2	3	2	2	2	3	1	1
Globigerinidae	1	1									2	2			2	3	6	12	7	14	8	20	6	12	6	12	6	10
Globorotaliidae			1	1							1	2	1	1	1	2	1	4	1	6	1	5	1	3	1	5	1	6
Anomalinidae	2	8	2	3	1	1	2	2	1	2	2	8	2	11	2	9	3	9	4	14	3	9	1	4	4	21	1	5
Planorbulinidae	1	1					2	3			1	1	3	4	1	2	2	2							1	1		
Rupertiidae													1	1							1	1			1	2		
Homotremidae	1	1			1	1	1	1			1	1																
Total	37	92	19	65	30	48	27	56	13	53	53	145	50	137	44	111	56	130	46	85	59	118	30	53	72	198	23	50
Number of families	18		9		17		16		7		20		21		17		18		15		20		16		25		13	

TABLE 2

Family	Station														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Astrorhizidae											3.4		0.5		
Rhizamminidae				1 8											
Saccamminidae									0.8		5.9				
Hyperamminidae											2.5		0.5		
Reophacidae			2.1				0.7		0.8		5.1		1.0		
Ammodiscidae											2.5	3.8	0.5		
Lituolidae				1.8			0.7			1.2	9.4	3.8	1.6	4	
Textulariidae	3.3		10.4	1.8		2.8	4.4	9.0	10.8	2.4	0.8		6.6		
Verneuilinidae	2.2	3.1	4.2			2.1	0.7	0.9	2.3	5.8	3.4		3.5	4	
Valvulinidae	1.1	3.1		1.8	3.8								0.5		
Miliolidae	39.2	52.3	22.9	46.4	60.4	42.1	42.4	32.5	20.0	14.1	10.3	17.0	23.2	14	7.8
Ophthalmidiidae	4.4	3.1	4.2			3.4	4.4	3.6			2.5	1.9	2.5		
Fischerinidae						0.7									
Trochamminidae				1.8			0.7			2.4	1.7	3.8	2.5		3.9
Lagenidae							1.5	1.8	16.2	7.1	9.3	5.7	8.1	10	19.6
Polymorphinidae	2.2					2.1	1.5	6.3	1.5					2	2.0
Nonionidae	7.6	7.7	4.2	8.9	9.4	5.5	4.4	5.4	3.1	1.2		1.9	3.0	2	3.9
Camerinidae			4.2	1.8			0.7								
Peneroplidae	12.0	10.8	12.5	8.9	9.4	7.6	6.6	9.0	2.3			1.9	3.5		
Alveolinellidae	1.1		2.1	1.8		0.7	0.7	0.9							
Heterohelicidae	1.1					0.7									
Buliminidae	2.2		6.2			6.2	4.4	2.7	9.2	8.2	6.8	3.8	7.1	4	2.0
Rotaliidae	8.6	13.8	12.5	7.1	11.3	12.3	11.7	10.8	7.7	7.1	1.7	7.5	7.6	10	11.8
Amphisteginidae	2.2		2.1	3.6		1.4		1.8	1.5				2.0		
Calcarinidae			4.2				1.5								
Cymbaloporettidae	1.1		2.1	1.8	1.9	2.1	0.7			1.2		1.9	1.0		
Cassidulinidae			2.1			0.7			2.3	5.8	2.5	7.5	2.5	6	3.9
Chilostomellidae								0.9	0.8	3.5	2.5	3.8	1.5	2	3.9
Globigerinidae	1.1					1.4		2.7	9.2	16.5	17.1	22.6	6.2	20	23.6
Globorotaliidae		1.5				1.4	0.7	1.8	3.1	7.0	4.2	5.7	2.5	12	13.7
Anomalinidae	8.6	4.6	2.1	3.6	3.8	5.5	8.0	8.1	7.0	16.5	7.6	7.5	10.6	10	3.9
Planorbulinidae	1.1					0.7	2.9	1.8	1.5				0.5		
Rupertiidae				5.4			0.7				0.8		1.0		

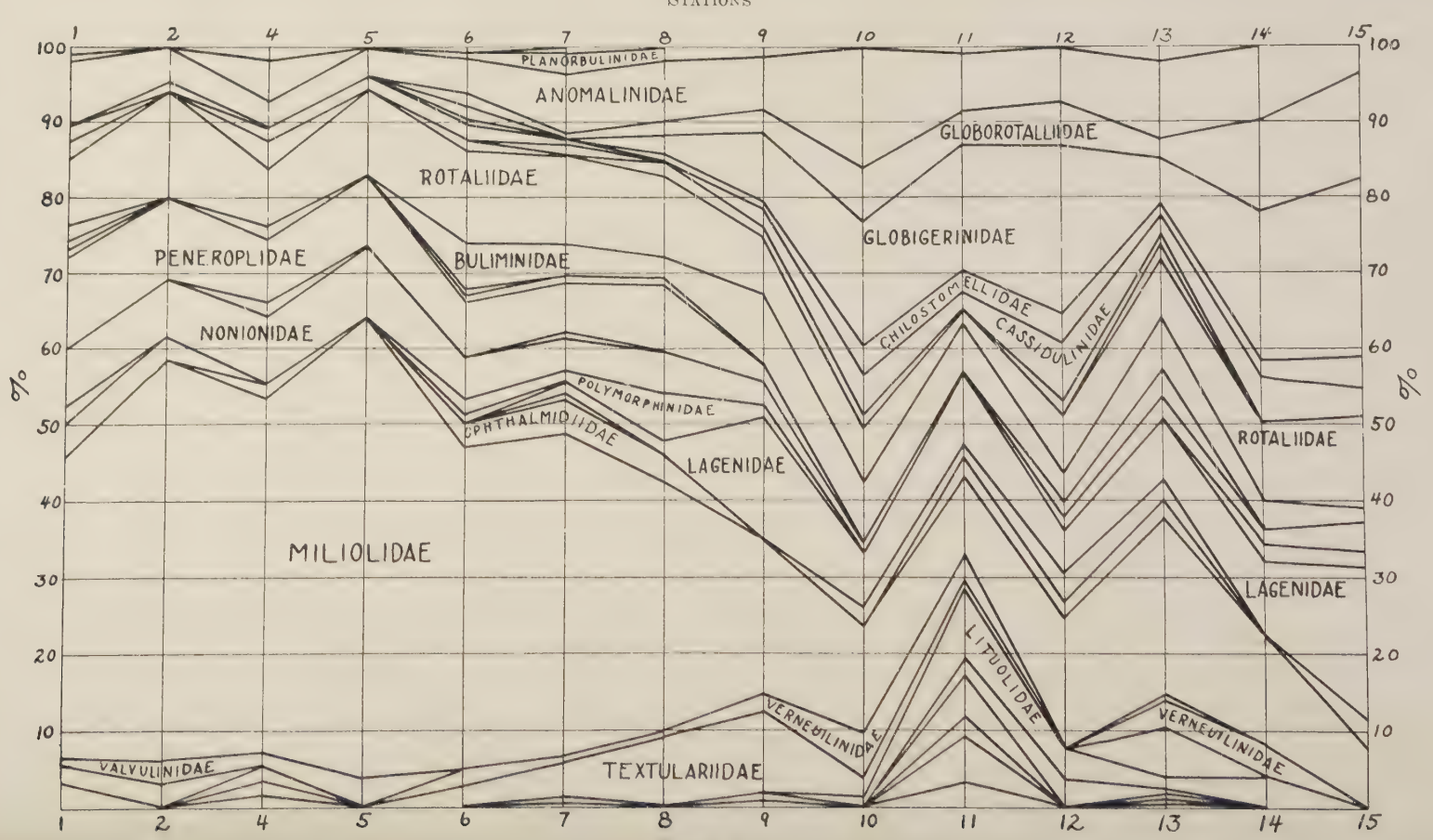
STATIONS
1 2 4 5 6 7 8 9 10 11 12 13 14 15
100 90 80 70 60 50 40 30 20 10
%
PLANORBULINIDAE
ANOMALINIDAE
GLOBOROTALLIIDAE
ROTALIIDAE
GLOBIGERINIDAE
PENEROPLIDAE
BULIMINIDAE
CHILOSTOMELLIDAE
CASSIDULINIDAE
NONIONIDAE
POLYMORPHINIDAE
OPHTHALMIDIIDAE
ROTALIIDAE
LAGENIDAE
MILIOLIDAE
LAGENIDAE
LITUOLIDAE
VERNEUILINIDAE
VERNEUILINIDAE
VALVULINIDAE
TEXTULARIIDAE

Fig. 1

TABLE 3

	A	B	C	D
Astrorhizidae			1.6	
Rhizamminidae	.6			
Saccamminidae		.3	2.3	
Hyperamminidae			1.0	
Reophacidae		.7	2.6	
Ammodiscidae			1.6	
Lituolidae	.6	.3	4.0	2.6
Textulariidae	1.9	6.1	5.3	
Verneuilinidae	1.9	2.0	3.3	2.6
Valvulinidae	1.3		.3	
Miliolidae	45.2	32.4	17.8	13.2
Ophthalmidiidae	3.2	2.4	3.0	
Fischerinidae		.3		
Trochamminidae	.6	.3	3.0	2.6
Lagenidae		7.4	9.5	19.7
Polymorphinidae	1.3	3.4		2.6
Nonionidae	8.9	3.4	2.3	2.6
Camerinidae	.6	.3		
Peneroplidae	8.3	4.7	2.3	
Alveolinellidae	.6	.3		
Heterohelicidae	.6	.3		
Buliminidae	1.3	7.4	8.6	3.9
Rotaliidae	11.5	9.5	6.6	7.9
Amphisteginidae	1.3	.7	1.3	
Calcarinidae				
Cymbaloporettidae	.6	1.0	1.0	
Cassidulinidae		1.0	3.0	5.3
Chilostomellidae		.6	1.0	2.6
Globigerinidae	.6	4.4	6.6	15.8
Globorotaliidae	.6	1.4	2.3	9.2
Anomalinidae	5.7	6.1	8.6	9.2
Planorbulinidae	1.9	2.0	.3	
Rupertiidae		.3	1.0	
Homotremidae	.6	.3		

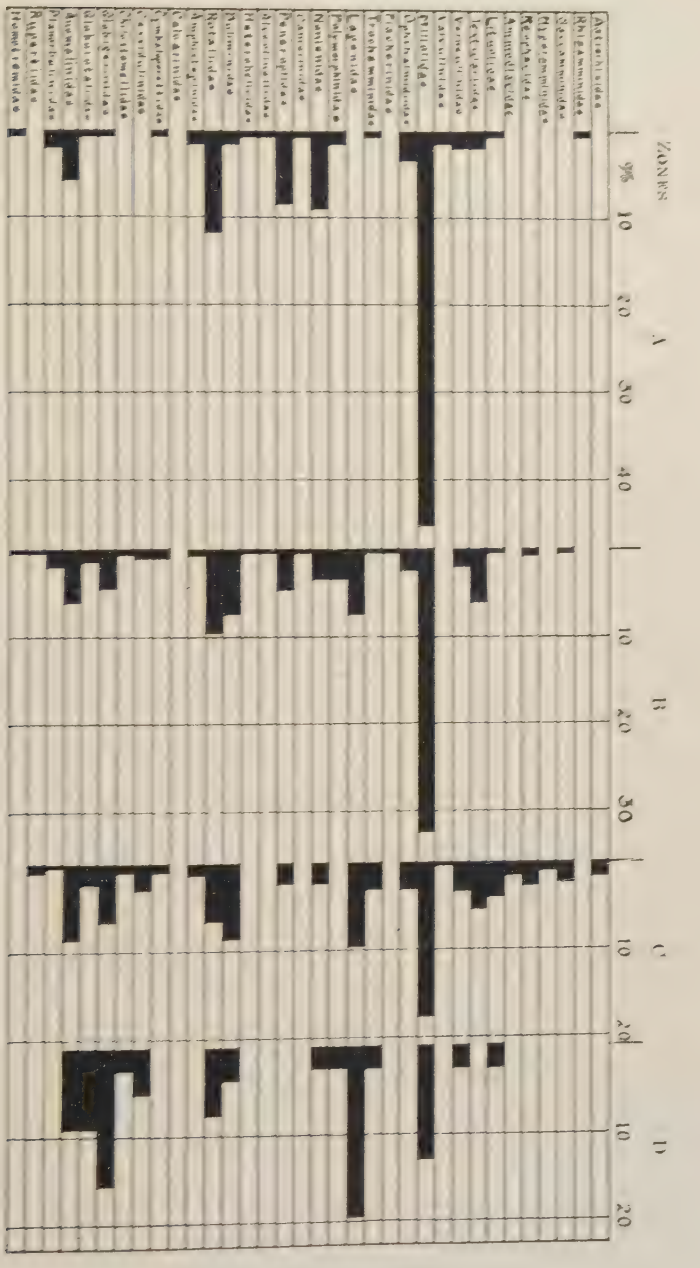
Astrorhizidae
Rhabdamminidae
Saccamminidae
Hyperammidae
Reophacidae
Ammodiscidae
Lituolidae
Textulariidae
Verneuilinidae
Ataxophragmiidae
Valvulinidae
Fischerinidae
Trochamminidae
Lagenidae
Polymorphinidae
Nonionidae
Cassidulinidae
Pleurostomellidae
Allomorphinidae
Heterohelicidae
Buliminidae
Rotaliidae
Amphisteginidae
Calcarinidae
Cymbaloporidae
Cymbaloporettidae
Discorbidae
Globigerinidae
Globorotaliidae
Anomalinidae
Planorbulinidae
Rupertiidae
Homotrematidae
ZONES
A
B
C
D
90
10
20
30
40
10
20
30
10
20
10
20

FIG. 3

In the check list, a quantitative scheme is used to show the relative abundance of a form: R = rare, F = few, C = common, and A = abundant. In order to arrive at an idea of the relative abundance of the different families at the several stations, a value is arbitrarily assigned to each letter: R = 1, F = 3, C = 10, A = 100.

Table 4 shows the approximate percentage of abundance for each family in the four zones, A, B, C, and D.

Figure 3 is a graphic interpretation of table 4.

Table 5 shows the percentage of abundance for each family at the fifteen stations based on these approximate figures.

TABLE 4

	A	B	C	D
Astrorhizidae			.8	
Rhizamminidae	.1			
Saccamminidae		.2	.4	
Hyperamminidae			.3	
Reophacidae		.3	.5	
Ammodiscidae			.3	
Lituolidae	.1	.07	1.5	.6
Textulariidae	.8	9.9	.9	
Verneuilinidae	1.0	.7	1.1	.6
Valvulinidae	4.2		.05	
Miliolidae	34.5	25.9	5.4	3.3
Ophthalmidiidae	1.0	2.4	.6	
Fischerinidae		.07		
Trochamminidae	.1	.07	.6	.6
Lagenidae		2.9	2.5	4.5
Polymorphinidae	.3	.9		.6
Nonionidae	4.8	3.5	.4	.9
Camerinidae	.1	.07		
Peneroplidae	37.6	11.7	.5	
Alveolinellidae	.6	.2		
Heterohelicidae	.1	.07		
Buliminidae	.3	2.9	1.6	.9
Rotaliidae	7.0	6.0	2.5	5.7
Amphisteginidae	2.2	15.7	.4	
Calcarinidae				
Cymbaloporettidae	.9	.3	.4	
Cassidulinidae		.3	2.3	1.5
Chilostomellidae		.1	.7	.9
Globigerinidae	.1	9.4	47.7	33.2
Globorotaliidae	.1	1.7	24.1	41.1
Anomalinidae	3.0	3.3	4.2	5.4
Planorbulinidae	.6	1.0	.05	
Rupertiidae		.07	.2	
Homotremidae	.6	.07		

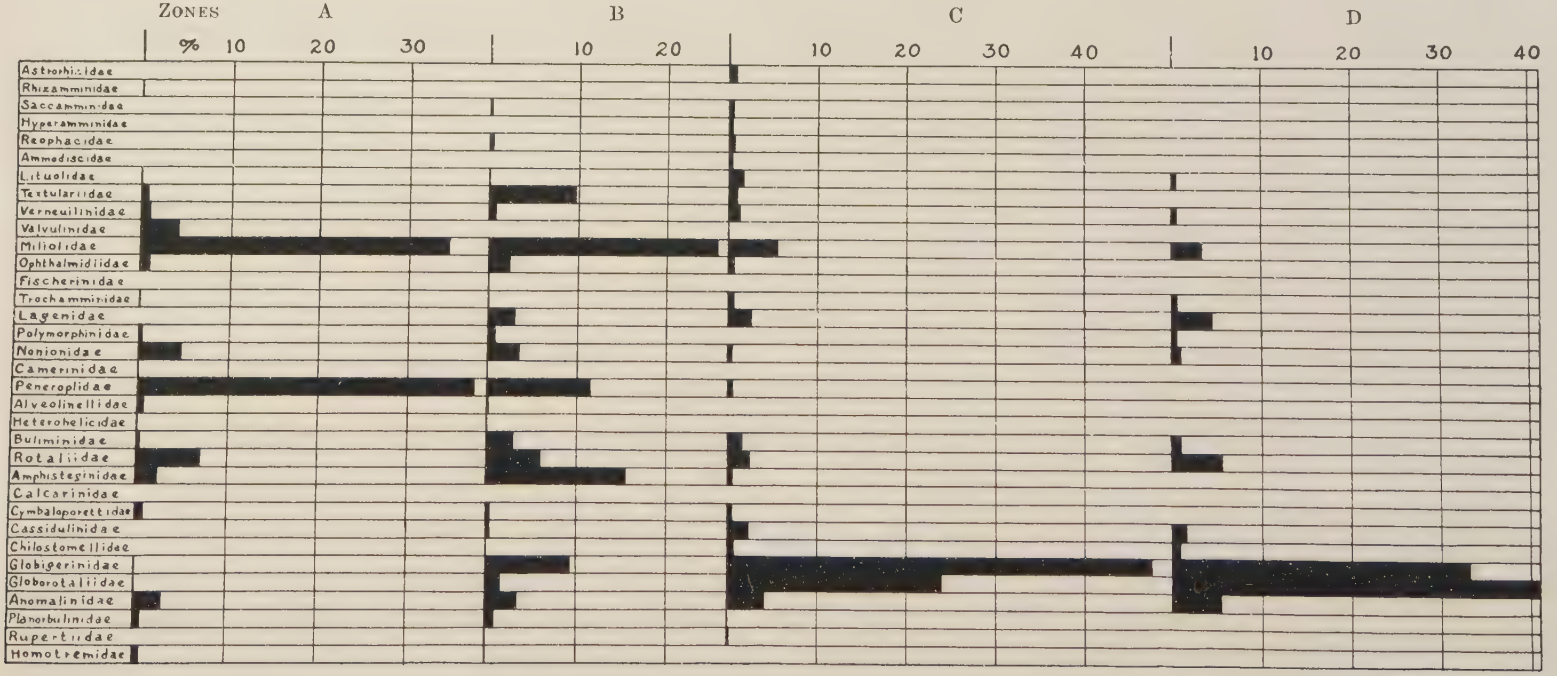
Zones
A
B
C
D
%
10
20
30
10
20
10
20
30
40
10
20
30
40
Astrorhizidae
Rhizamminidae
Saccamminidae
Hyperamminidae
Reophacidae
Ammodiscidae
Lituolidae
Textulariidae
Verneuilinidae
Valvulinidae
Miliolidae
Ophthalmidiidae
Fischerinidae
Trochamminidae
Lagenidae
Polymorphinidae
Nonionidae
Camerinidae
Peneroplidae
Alveolinellidae
Heterohelicidae
Buliminidae
Rotaliidae
Amphisteginidae
Calcarinidae
Cymbaloporettidae
Cassidulinidae
Chilostomellidae
Globigerinidae
Globorotaliidae
Anomalinidae
Planorbulinidae
Ruperttiidae
Homotremidae

Fig. 3

TABLE 5

Family	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Astrorhizidae											2.3		.2		
Rhizamminidae				.8											
Saccamminidae									.6		1.1				
Hyperamminidae											.8		.2		
Reophacidae			.3				.2		.6		1.2		.4		
Ammodiscidae											.5	1.1	.2		
Lituolidae				.8			.2			.2	4.1	1.1	.6	.9	
Textulariidae	1.6		1.3	2.3		6.9	9.4	15.4	8.1	.3	.2		2.8		
Verneuilinidae	2.1	1.7	.5			1.2	.2	.9	.6	.9	1.5		1.3	.9	
Valvulinidae	5.4	5.4		2.3	2.8								.2		
Miliolidae	36.9	28.8	3.9	41.9	34.3	35.0	41.6	19.2	10.6	2.4	2.5	4.9	12.2	3.0	4.0
Ophthalmidiidae	3.2	.8	.5			7.3	2.6	1.8			.5	.5	1.3		
Fischerinidae						.4									
Trochamminidae				.8			.2			.3	.3	1.1	.9		2.0
Lagenidae							.4	.6	8.5	1.4	2.0	1.6	4.6	2.2	10.0
Polymorphinidae	1.1					1.2	.4	2.1	.4					.4	1.0
Nonionidae	3.7	5.8	3.4	7.0	3.3	7.7	4.1	3.5	.9	.2			1.1	.4	2.0
Camerinidae			1.0	.8			.2								
Peneroplidae	22.4	47.9	3.1	14.0	53.0	8.5	26.4	9.5	.6			.5	1.7		
Alveolinellidae	1.6		.3	.8		.4	.2	.3							
Heterohelicidae	0.5					.4									
Buliminidae	1.1		.8			7.3	1.3	.9	3.8	1.2	1.2	1.1	2.8	.9	1.0
Rotaliidae	9.7	6.2	27.2	10.0	3.8	12.2	5.1	5.3	4.2	1.0	.6	2.2	6.5	4.8	8.0
Amphisteginidae	2.1		25.9	10.0		2.5	2.8	32.6	23.4				1.5		
Calcarinidae			28.5												
Cymbaloporettidae	1.6		.3	2.3	.5	1.2	.2			.2		1.6	.7		
Cassidulinidae			.3			.4			.6	1.6	.8	3.3	4.6	1.3	2.0
Chilostomellidae								.3	.2	.5	.8	1.1	.6	.4	2.0
Globigerinidae	0.5					.8		1.5	29.1	63.3	43.7	70.0	28.7	30.0	40.0
Globorotaliidae		.4				.8	.2	1.8	3.6	21.9	33.4	7.6	21.3	47.4	27.0
Anomalinidae	5.4	2.9	.3	1.6	1.9	4.1	2.8	3.8	3.2	4.7	3.1	2.2	5.7	7.0	2.0
Planonbulinidae	0.5			2.3		1.2	1.3	.6	.9				.2		
Rupertiidae							2				.2		.2		

A List of Forms Rather Closely Confined to Zones A and B (0 to 60 Fathoms) and Common in Some Tropical and Subtropical Regions

Textulariidae
- Textularia agglutinans d'Orbigny
  - candeiana d'Orbigny
- Bigenerina nodosaria d'Orbigny

Verneuilinidae
- Clavulina tricarinata d'Orbigny

Valvulinidae
- Valvulina oviedoiana d'Orbigny

Miliolidae
- Quinqueloculina agglutinans d'Orbigny
  - bidentata d'Orbigny
- Schlumbergerina alveoliniformis (Brady)
- Articulina sagra d'Orbigny
- Triloculina carinata d'Orbigny
  - planciana d'Orbigny
  - fichteliana d'Orbigny
- Pyrgo subsphaerica d'Orbigny

Ophthalmidiidae
- Planispirina auriculata Egger
- Vertebralina cassis var. mucronata d'Orbigny

Nonionidae
- Nonion grateloupi d'Orbigny
- Elphidium poeyana d'Orbigny
  - macella (Fichtel and Moll)
  - advena Cushman
  - discoidalis d'Orbigny

Camerinidae
- Heterostegina antillarum d'Orbigny

Peneroplidae
- Peneroplis pertusus Fôrskal
  - arietinus (Batsch)
  - discoideus Flint
  - proteus d'Orbigny
  - sp. cf. P. planatus (Fichtel and Moll)
- Archaias aduncus (Fichtel and Moll)
  - compressus d'Orbigny
- Amphisorus duplex Carpenter
- Borelis pulchra d'Orbigny

Buliminidae
- Virgulina punctata d'Orbigny
- Reussia spinulosa Reuss

Rotaliidae
- Discorbis candeiana d'Orbigny
  - mira Cushman
- Rotalia rosea d'Orbigny

Amphisteginidae
Asterigerina carinata d'Orbigny
Amphistegina lessoni d'Orbigny
Calcarinidae
Calcarina spengleri (Linnaeus)
Baculogypsina sphaerulatus (Parker and Jones)
Anomalinidae
Cibicides advena d'Orbigny
Planorbulinidae
Planorbulina acervalis Brady
Homotremidae
Homotrema rubrum (Lamarck)
Polytrema miniacea (Pallas)

CONCLUSIONS

This study has brought out certain facts bearing on the ecologic distribution of some of the foraminifera.

In the very shallow-water zone A, from 0–5 fathoms, where the temperature range is between 21° and 32° C, the Miliolidae and Peneroplidae are generally common to abundant. In certain restricted areas, the Valvulinidae, Calcarinidae, Homotremidae, and Nonionidae, are rather common.

The next lower zone, B, from 5 to 60 fathoms, temperature range 20°–31° C, a marked decrease in the Peneroplidae and Miliolidae both in number of species and in individuals is noted. The Lagenidae, Textulariidae, Buliminidae, and Amphisteginidae are often common at these depths.

In zones C and D, from 500–2850 fathoms, in temperatures from 2°–8° C, families of Globigerinidae and Globorotaliidae are predominant. The Lagenidae and Buliminidae persist to great depths but usually in small numbers. The Rotaliidae and Anomalinidae are rather uniformily present at nearly all depths and, as families, do not seem to possess definite ecologic value.

The writer believes that a study of the ecologic conditions and the habitat of these organisms will yield valuable data which can be used in the interpretation of sediments deposited in the past.

In the following check list of foraminifera (table 6), the sample numbers are placed at the top of the respective columns. The quantitative scheme is based on the frequency with which the species were encountered in the study. The symbols used in the table are:

A = abundant, C = common, F = few, R = rare.

TABLE 6

List of Species and the Numbers for the Stations at which they were Found

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
FAMILY ASTRORHIZIDAE															
Astrorhiza sp. *A*													R		
Rhabdammina discreta Brady											C				
linearis Brady											F				
Crithionina granum Goës											R				
pisum var. *hispida* Flint											R				
FAMILY RHIZAMMINIDAE															
Rhizammina sp. cf. *R. algaeformis* Brady				R											
FAMILY SACCAMMINIDAE															
SUBFAMILY PSAMMOSPHAERINAE															
Psammosphaera fusca F. Schultze											R				
rustica Heron-Allen and Earland											R				
SUBFAMILY SACCAMMININAE															
Saccammina sphaerica M. Sars									F		R				
Proteonina testacea Flint											R				
difflugiformis Brady											R				
sp. cf. *P. helenae* Rhumbler											R				
Thurammina favosa Flint											R				
FAMILY HYPERAMMINIDAE															
SUBFAMILY HYPERAMMININAE															
Hyperammina laevigata Wright											R		R		
sp. *A*											F				
SUBFAMILY DENDROPHRYINAE															
Saccorhiza ramosa Brady											R				
FAMILY REOPHACIDAE															
SUBFAMILY ASCHEMONELLINAE															
Aschemonella catenata Norman											R				
SUBFAMILY REOPHACINAE															
Reophax scorpiurus Montfort			R						F				R		
dentaliniformis Brady											R				
agglutinatus Cushman											F				
nodulosus Brady							R				R				
sp. cf. *R. bilocularis* Flint											R				
Hormosina globulifera Brady											R				
Haplostiche dubia d'Orbigny													R		

TABLE 6—(*Continued*)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
FAMILY AMMODISCIDAE															
SUBFAMILY AMMODISCINAE															
Ammodiscus incertus (d'Orbigny)												R	R		
Glomospira gordialis Jones and Parker												R			
Lituotuba lituiformis (Brady)											R				
SUBFAMILY TOLYPAMMININAE															
Tolypammina vagans Brady											R				
Ammolagena clavata Parker and Jones											R				
FAMILY LITUOLIDAE															
SUBFAMILY HAPLOPHRAGMIINAE															
Trochamminoides proteâs (Karrer)										R	R			R	
Haplophragmoides ringens (Brady)											R				
sphaeriloculum Cushman												R	R		
subglobosum (Sars)											C	R			
subglobosum (Sars) var.											R				
emaciatum (Brady)											F			R	
sp. cf. *H. coronata* (Brady)											R				
sp. cf. *H. rotulatum* (Brady)											R				
canariensis d'Orbigny											R				
Cribrostomoides bradyi Cushman											R				
Ammobaculites sp. cf. *A. reophaciformis* Cushman				R			R								
SUBFAMILY LITUOLINAE															
Cyclammina cancellata Brady											F		R		
sp. cf. *C. pusilla* Brady											R		R		
FAMILY TEXTULARIIDAE															
SUBFAMILY SPIROPLECTAMMININAE															
Spiroplectammina biformis (Parker and Jones)											R				
sp. cf. *S. wrighti* (Silvestri)								R							
SUBFAMILY TEXTULARIINAE															
Textularia milletti Cushman										R					
conica d'Orbigny	R		R			R	F	F	F				R		
candeiana d'Orbigny						F	C	C	C				R		
agglutinans d'Orbigny	R		R	F		C	C	C	C				R		
floridana d'Orbigny								F	F						
flinti Cushman									R						
gramen d'Orbigny			R					R	R				R		
mississippiensis Cushman									R						

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
goësii Cushman									R				R		
mayori Cushman								F	R						
sp. cf. *T. hauerii* Cushman							R								
porrecta Brady													R		
siphonifera Brady			R										R		
concava var. *heterostoma Fornasini*													R		
rugosa Reuss			R												
pseudotrochus Cushman									R				F		
sp. *A*									R						
sp. *B*									R						
sp. *C*													R		
Textulariella barretti (Jones and Parker)									F						
Bigenerina nodosaria d'Orbigny	R					F	C	C	R				R		
nodosaria var. *textulariodea* Goës							C	C					R		
sp. cf. *B. robusta* Brady								R							
sp. *A*													R		
sp. *B*										R					
FAMILY VERNEUILINIDAE															
Verneuilina bradyi Cushman									R		F		R	R	
sp. *A*	R														
Gaudryina flinti Cushman									R		F		R		
rudis Wright													R		
bradyi Cushman										R	R		R	R	
robusta Cushman											F		R		
pseudofiliformis Cushman										R					
apicularis Cushman										R					
sp. *A*										R			R		
Clavulina nodosaria d'Orbigny						R									
nodosaria var. *novangliae* Cushman													R		
tricarinata d'Orbigny	F	R	R			R	R	F							
sp. cf. *C. parisiensis* d'Orbigny									R						
sp. *A*		F				R									
sp. *B*										R					
sp. *C*			R												
FAMILY VALVULINIDAE															
Valvulina oviedoiana d'Orbigny	C	C		F	F										
oviedoiana d'Orbigny var.		F			F										
sp. *A*													R		

TABLE 6—(*Continued*)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
FAMILY MILIOLIDAE															
Quinqueloculina crassa d'Orbigny													R		
agglutinata Cushman									R				F		
agglutinans d'Orbigny	F	F		C	F	F	C	C					R		
striata d'Orbigny		F			R			R	R				R		
costata d'Orbigny	R	F		R		R	F		R				F		
poeyana d'Orbigny	R	R		R	R	R	F	R					R		
subpoeyana Cushman	R					R	R								
funafutiensis Chapman				R		R	R								
laevigata d'Orbigny	R	R		R	R	R	R	R	R	R			R		
candeiana d'Orbigny					R	R	R	F	F						
lamarckiana d'Orbigny	R	R		F	C	R	A	F	F		R		R		
auberiana d'Orbigny						R	F	R	R		R		F		R
cuvieriana d'Orbigny							R	F				R	R		
bidentata d'Orbigny	R	F				R	F	R							
seminulum (Linnaeus)		R			R						R	R		R	R
seminulum (Linnaeus) var.										R	R		R		
sp. cf. *Q. reticulata* d'Orbigny		R													
sp. cf. *Q. reticulata* d'Orbigny var.			F												
parkeri Brady			R										F		
parkeri var. *occidentalis* Cushman	F			R		R									
sp. cf. *Q. scrobiculata* Brady					R		R								
cultrata Brady					R		R						R	R	
bicostata d'Orbigny									F						
bicornis (Walker and Jacob)									R						
polygona d'Orbigny	F	R			R	F	R	F	F				R		
sp. cf. *Q. cookei* Cushman	R								R						
sp. cf. *Q. vulgaris* d'Orbigny							F		R						
subarenaria Cushman				R				R							
sp. cf. *Q. glabrata* Cushman								R							
bradyana Cushman	F	F		F	F	F	R				R		R		
sp. cf. *Q. antillarum* d'Orbigny				R											
sp. cf. *Q. exsculpta* Heron-Allen and Earland	R														
dilatata d'Orbigny	F	F			F	R						R	R		
sp. cf. *Q. kerimbatia* var. *reticulo-striata* Cushman	R					R									
sp. cf. *Q. tricarinata* d'Orbigny	R			R		R									

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
undosa Karrer			R			R	R						R		
venusta Karrer						R							R	R	
collumnosa Cushman						R									
limbata d'Orbigny		R			R	R	R	R							
sp. cf. *Q. samoaensis* Cushman			R	R	R	R	R						R		
boneana d'Orbigny			R			R	R						R		
separans Brady		R													
Quinqueloculina sp. *A*						R		R							
sp. *B*								R							
sp. *C*						R									
sp. *D*		R		R		R	R						R		
sp. *E*				R		R	R						R		
sp. *F*					R		R								
sp. *G*		R													
sp. *H*			R												
sp. *I*						R	R								
sp. *J*															R
Schlumbergerina alveoliniformis (Brady)			R			R	R								
Massilina macilenta Brady	R					R							R		
crenata (Karrer)							R								
sp. cf. *M. inequalis* Cushman						R									
arenaria Brady									R						
annectens Schlumberger								R							
Spiroloculina depressa d'Orbigny									R	R					
validus Cushman									F						
antillarum d'Orbigny						R		R							
var. *angulata* Cushman						R	R	R							
planulata (Lamarck)								R							
grateloupi d'Orbigny						R	R	F							
ornata d'Orbigny						R		R							
sp. cf. *S. convexiuscula* Brady						R									
eximia Cushman						R									
arenata Cushman						R	R								
caduca Cushman							R								
sp. *A*			R												
Hauerina bradyi Cushman	F					R	F								
sp. cf. *H. fragilissima* Brady						R	R	R					R		
ornatissima Karrer							R						R		

TABLE 6—(*Continued*)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Sigmoilina schlumbergeri Silvestri									F	R	F		R		
sigmoidea Brady											R		F		
Articulina sulcata Reuss ?						R	R						R		
mexicana Cushman		R					R	R							
conico-articulata (Batsch)	R						R	R							
sagra d'Orbigny	R	R		R	R	R	R	R					R		
lineata Brady	R				R										
mayori Cushman					R	R	R								
antillarum Cushman						F									
sp. *A*		R													
Nubeculina divaricata var. *advena* Cushman													R		
Triloculina oblonga (Montagu)	C	F	F	C	C	F	F	F	F		R	R	F		R
oblonga Montagu var.					F										
insignis Brady							R								
trigonula (Lamarck)				R	R	F	R	R	F				R		
tricarinata d'Orbigny			R									R			
bicarinata d'Orbigny		F				R	F	F					R		
carinata d'Orbigny	F			F	C	R	F	R							
planciana d'Orbigny	R	R			R	R	F	R							
circularis Bornemann	F	F		F	F	F	F	F		R	R		F		
circularis var. *sublineata* Brady					R										
labiosa d'Orbigny	F	F			F	R		R							
linneiana d'Orbigny	F	F		R	R	R	F	F					R		
gracilis d'Orbigny	R					R									
rotunda d'Orbigny	R	F		F	R	F	F						F		
quadrilateralis d'Orbigny	F	C			F	R	F						F		
fichteliana d'Orbigny	R	R				R	R		R						
transversestriata Brady	R					R	R								
sp. cf. *T. cuneata* Karrer		R				R	R								
terquemiana Brady							R								
sp. *A*				R											
sp. *B*							R								
sp. *C*				R											
sp. *D*					R										
sp. *E*					R										
Flintina bradyana Cushman		R													
sp. cf. *F. triquetia* Brady		R													
sp. *A*		R													

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Pyrgo depressa d'Orbigny									R	R	F			R	
globulus Bornemann													R		
servata L. W. Bailey										R					
sp. cf. *B. tubulosa* Costa													R		
sp. cf. *B. bulloides* d'Orbigny			R												
laevis Defrance												R	R		
sarsi Schlumberger									R						
murrhyna Schwager						R			F	R			R		
anomala Schlumberger				R					F				R		
elongata d'Orbigny									R					R	
vespertilio Schlumberger									F						
subsphaerica d'Orbigny	F					C	R	R							
denticulata Brady var.				R			F	F	F				R		
denticulata var. *striolata* Brady	R												R		
lucernula Schwager		R				R	R							R	
sp. cf. *B. milletti* Cushman							R								
sp. cf. *B. irregularis* d'Orbigny										F	R	R	F	R	
sp. *A*	R	F			R	R				R			R		
sp. *B*	R														
sp. *C*	R														
sp. *D*								R							
sp. *E*				R											
sp. *F*							R								
sp. *G*												R			
sp. *H*										R					
sp. *I*										R	R	R			
FAMILY OPHTHALMIDIIDAE															
SUBFAMILY CORNUSPIRINAE															
Cornuspira involvens Reuss			R			C	R	R					R		
crassisepta Brady												R			
lacunosa Brady											R				
sp. *A*							R								
SUBFAMILY OPHTHALMIDIINAE															
Ophthalmidium? sp. *A*											R				
Planispirina auriculata Egger			R			F	F	R							
sphaera (d'Orbigny)											R				
sp. *A*		R													

TABLE 6—(*Continued*)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Vertebralina cassis d'Orbigny	R					R	F	R					F		
cassis var. *mucronata* d'Orbigny	F					F	F	F							
striata d'Orbigny							R								
insignis Brady													R		
sp. *A*													R		
SUBFAMILY NUBECULARIINAE															
Nubecularia sp. cf. *N. lucifuga* Defrance	R														
Silvestria inflata (Brady)	R	R				R							R		
FAMILY FISCHERINIDAE															
Fischerina dubia (d'Orbigny)						R									
FAMILY TROCHAMMINIDAE															
SUBFAMILY TROCHAMMININAE															
Trochammina advena Cushman							R								
squamata Jones and Parker				R							R				
globigeriniformis Parker and Jones												R			
globulosa Cushman										R	R				R
sp. cf. *T. turbinata* (Brady)													R		
sp. cf. *T. nana* (Brady)													R		
sp. *A*												R	R		
sp. *B*													R		
SUBFAMILY GLOBOTEXTULARIINAE															
Globotextularia sp. cf. *G. anceps* (Brady)													R		R
Ammochilostoma pauciloculata (Brady)										R					
FAMILY LAGENIDAE															
SUBFAMILY NODOSARIINAE															
Robulus calcar (Linnaeus)							R		F				R		
lucida Cushman									R				R		
d'orbignyi Bailey									R						
gibba d'Orbigny?											R		R		
Lenticulina sp. cf. *L. rotulata* Lamarck									R	R	F	R	C		
vortex (Fichtel and Moll)													R		
peregrina Schwager									R	F	R	R			
orbicularis d'Orbigny									R				R		
convergens Bornemann									R				R		
crepidula (Fichtel and Moll)									F						
occidentalis var. *torrida* Cushman									R		R				
obtusa var. *subalata* Brady											R				

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
iota Cushman											R				
sp. *A*									R						
sp. *C*													R		
sp. *D*													R		
sp. *E*													R		
Marginulina costata (Batsch)									R				R		
bacheii Bailey									F						
tenius Bornemann?										R					
Dentalina communis d'Orbigny									F		R		R		
advena Cushman											R				
Nodosaria flinti Cushman									R		R				
intercellularis Brady									R						
vertebralis var. *albatrossi* Cushman													R		
antillea Cushman															R
sublineata Brady										R					
subsoluta Cushman											R				
sp. *A*							R	R							
sp. *B*															R
Glandulina laevigata var. *occidentalis* Cushman										R					
laevigata var. *torrida* Cushman													R		
Saracenaria italica Defrance									F						
acutamicularis (Fichtel and Moll) ?									R						
Vaginulina advena Cushman									R	R					
linearis (Montagu)								R	C						
Frondicularia sagittula Van den Broeck									R						
SUBFAMILY LAGENINAE															
Lagena squamosa Montagu									R						
marginata (Walker and Boys)												R			
marginata var.														R	
sp. cf. *L. quadrata* Williamson													R		
globosa Montagu											R				
sulcata var. *alticosta* Cushman															R
sp. cf. *L. iota* Cushman															R
orbignyana Seguenza var.															R
marginato-perforata Seguenza															R
flintiana Cushman															R
apiculata Reuss															R

TABLE 6—(*Continued*)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
laevis Montagu													R		
semiformis Schwager														R	
sp. cf. *L. plumigera* Brady														R	
sacculus Fornasini														R	
sp. *A*															R
sp. *B*															R
sp. *C*														R	
FAMILY POLYMORPHINIDAE															
Guttulina communis d'Orbigny									R						
problema d'Orbigny								R							
spinosa d'Orbigny															R
oblonga d'Orbigny							R								
Pyrulinella lanceolata Reuss														R	
lactea (Walker and Jacob)	R					R		R	R						
lactea var. *novangliae* Cushman						R									
sp. cf. *P. vitrea* d'Orbigny								R							
Polymorphina pulchella d'Orbigny						R		R							
regina Brady, Parker and Jones ?	R						R	R							
sp. *A*								R							
sp. *B*								R							
FAMILY NONIONIDAE															
Nonion scapha (Fichtel and Moll)		R		F		R		R	R				R		
Nonion scapha (Fichtel and Moll) var. *pompilioides* (Fichtel and Moll)															R
stelligera d'Orbigny														R	R
umbilicatula (Montagu)									R						
grateloupi d'Orbigny					R				R				R		
depressula (Walker and Jacob)						F	R	F					R		
sp. *A*	R									R		R			
Elphidium poeyana d'Orbigny													R		
striatopunctata (Fichtel and Moll)		C		F	F	C	F	F	R				R		
macella (Fichtel and Moll)	R	R			R	R									
advena Cushman	R				R	R	R	R							
discoidalis d'Orbigny	R			R		R	R	R							
sp. cf. *E. laneri* d'Orbigny	R					R	C	F					R		
	R														

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
craticulata (Fichtel and Moll)			C												
milletti Heron-Allen and Earland			F												
sp. *A*				R											
sp. *B*				R											
sp. *C*	R														
sp. *D*		R													
sp. *E*		R			R	R	F								
FAMILY CAMERINIDAE															
Heterostegina antillarum d'Orbigny			R	R			R								
suborbicularis d'Orbigny			F												
FAMILY PENEROPLIDAE															
SUBFAMILY SPIROLININAE															
Peneroplis pertusus Förskal	F	R	F	R	R	R	F	F	R				R		
arietinus (Batsch)	R	R	R		R	R	R	R							
discoidcus Flint	R	R			R	R		F					R		
proteus d'Orbigny	C	A		F	C	F	F					R	R		
carinatus d'Orbigny	R					R		R							
sp. cf. *P. planatus* (Fichtel and Moll)	R		R			F							R		
laevigatus Karrer				R									R		
sp. *A*						R									
sp. *B*		R					R	R							
sp. *C*			R												
Spirolina sp. cf. *S. cylindraceus* (Lamarck)	R							R							
Monalysidium polita Chapman ?						R	R								
SUBFAMILY ARCHAIASINAE															
Archaias adunca (Fichtel and Moll)	C	C		C	A	F	A	C	R				F		
compressa d'Orbigny	F						C	C							
sp. *A*	R														
SUBFAMILY ORBITOLITINAE															
Sorites marginalis (Lamarck)						F	F	R	R				R		
Amphisorus duplex Carpenter	C	R	F	F		F	R	R							
Marginopora vertebralis quoyard Gaimard			F												
FAMILY ALVEOLINELLIDAE															
Borelis pulchra d'Orbigny	F		R	R		R	R	R							
FAMILY HETEROHELICIDAE															
SUBFAMILY BOLIVINITINAE															
Bolivinita rhomboidalis Millett	R					R									

TABLE 6—(*Continued*)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
FAMILY BULIMINIDAE															
SUBFAMILY TURRILININAE															
Buliminella subteres (Brady)								R	R	R	R				
elegantissima var. *seminuda* Terquem	R														
sp. *A*													R		
SUBFAMILY BULIMININAE															
Bulimina buchiana d'Orbigny													R		
aculeata d'Orbigny											R				
marginata Cushman									F						
ovata d'Orbigny									R						
inflata Seguenza										R		R	R		
inflata var. *mexicana* Cushman										R					
sp. cf. *B. pyrula* d'Orbigny											R				
SUBFAMILY VIRGULININAE															
Virgulina punctata d'Orbigny						C	R	R							
screibersiana Czjzek											R				R
sp. cf. *V. subdepressa* Brady			R												
Bolivina tortuosa Brady						R									
limbata var. *costulata* Cushman							R								
dilatata Reuss									R						
subaenariensis Cushman									R						
pulchella d'Orbigny	R					R		R		R					
striatula Cushman						R	R								
sp. cf. *B. porrecta* Brady						R									
sp. cf. *B. inflata* Heron-Allen and Earland			R												
compacta Sidebottom			R												
albatrossi Cushman											R				
sp. cf. *B. beyrichi* Reuss											R				
robusta Brady													R		
goësii Cushman													R		
sp. *A*							R								
sp. *B*										R					
Loxostomum mayori Cushman						R									
SUBFAMILY REUSSIINAE															
Reussia spinulosa Reuss						R	R	R	F				R		
spinulosa Reuss var. *glabrata* Cushman									R						

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
SUBFAMILY UVIGERININAE															
Uvigerina auberiana d'Orbigny										R				R	
auberiana d'Orbigny var.														R	
auberiana var. *laevis* Goës													R		
semicostata Cushman													R		
porrecta Brady													R		
peregrina Cushman											R		R		
peregrina Cushman var.													R		
peregrina var. *parvula* Cushman									R						
peregrina var. *bradyana* Cushman									R						
flinti Cushman									F				F		
pigmea d'Orbigny									R						
occidentalis Cushman												R			
ampullacea Brady											R				
sp. *A*									R						
sp. *B*													R		
Siphogenerina advena Cushman						R	R								
Angulogerina angulosa (Williamson)						R							R		
Trifarina bradyi Cushman										R					
FAMILY ROTALIIDAE															
SUBFAMILY SPIRILLININAE															
Spirillina decorata Brady										R					
vivipara Ehrenberg	R		R			F	R	R					R		
vivipara Ehrenberg var.						R	R	R							
sp. *A*			R												
SUBFAMILY DISCORBISINAE															
Discorbis turbo d'Orbigny													R		
globularis d'Orbigny													R		
vesicularis Lamarck										R					
orbicularis Terquem	R					F	R	R	R				R		
orbicularis Terquem var.							R								
bertheloti d'Orbigny		R				R	R	R	F						
mira Cushman	F	F	R		R	F	R	R							
allomorphinoides Reuss		R				R		R							
floridana Cushman						R									
subaraucana Cushman		R			R	F	F						R		
sp. cf. *D. rosacea* d'Orbigny													R		
sp. cf. *D. patelliformis* Brady		R					R								

TABLE 6—(*Continued*)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
sp. cf. *D. advena* Cushman						R									
sp. cf. *D. rugosa* d'Orbigny								R							R
auberii d'Orbigny						R									
candeiana d'Orbigny	R	F			F	F	F	F	F						
sp. *A*	R														
sp. *B*	R														
sp. *C*						R									
sp. *D*		R			R										
sp. *E*		R			R										
sp. *F*													R		
Lamarckina ? sp. *A*						R									
Valvulineria vilardeboana (d'Orbigny)		F	R			R	R						R		
Valvulineria vilardeboana (d'Orbigny) var.					R		R								
Gyroidina soldanii d'Orbigny									R	R		R		R	R
broeckhiana Karrer										R	F	R	F		
SUBFAMILY ROTALIINAE															
Eponides repanda (Fichtel and Moll)				R		R	F	F	R						
sp. cf. *E. haueri* Reuss														R	R
pygmaea Hautken							R						R	F	F
umbonata Reuss			R							R		R	R	F	R
incerta Cushman								R	F						
karsteni Reuss									R				R	F	R
sp. *A*												R			
Rotalia rosea d'Orbigny	C			C		F	R						R		
beccari (Linnaeus)	R			R			R	R							
calcar d'Orbigny			A												
SUBFAMILY SIPHONININAE															
Epistomina elegans d'Orbigny											R				
Siphonina reticulata Czjzek									R				C		
pulchra Cushman				R		R	F	F	F	R			C		
SUBFAMILY BAGGININAE															
Cancris semipunctata Cushman						R			F						
FAMILY AMPHISTEGINIDAE															
Asterigerina carinata d'Orbigny	F			C		F	C	A	A				F		
Amphistegina lessoni d'Orbigny	R		A	F		F	F	C	C				F		
cf. *A. madagascarensis* d'Orbigny													R		
sp. *A*													R		

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
FAMILY CALCARINIDAE															
Calcarina spengleri (Linnaeus)			C												
Baculogypsina sphaerulatus Parker and Jones			A												
FAMILY CYMBALOPORETTIDAE															
Cymbaloporetta squammosa d'Orbigny	F			F	R	R	R						F		
var. *bradyi* Cushman			R			R						F	R		
Tretomphalus bulloides d'Orbigny										R					
milletti Heron-Allen and Earland						R									
FAMILY CASSIDULINIDAE															
SUBFAMILY CERATOBULIMININAE															
Ceratobulimina contraria Reuss										R					R
Pulvinulinella culter (Parker and Jones)										R	R	R	F		
exigua Brady										R				R	R
SUBFAMILY CASSIDULININAE															
Cassidulina crassa d'Orbigny						R			R	F			R		
subglobosa Brady									R	F	F	F	C	R	
braziliensis Cushman									R						
favus Brady														R	
sp. *A*												R	C		
Cassidulinoides parkeriana Brady			R												
SUBFAMILY EHRENBERGININAE															
Ehrenbergina trigona Goës												R			
sp. cf. *E. trigona* var. *braziliensis* Cushman													R		
sp. cf. *E. pupa*											R				
FAMILY CHILOSTOMELLIDAE															
SUBFAMILY ALLOMORPHINELLINAE															
Pullenia quinqueloba Reuss										R	R		R	R	F
sphaeroides d'Orbigny									R	R	R	R	R		
SUBFAMILY SPHAEROIDININAE															
Sphaeroidina bulloides d'Orbigny								R		R	F	R	R		R
FAMILY GLOBIGERINIDAE															
SUBFAMILY GLOBIGERININAE															
Globigerina bulloides d'Orbigny								R	F	A	C	F	F	C	C
dubia Egger									C	C	A	A	A	C	F
dutertrei d'Orbigny								R			R				R
inflata d'Orbigny									R	C	R	R	C	C	C
sp. cf. *G. triloba* Reuss									R		R				
subcretacea Chapman ?										R	F	R	R		
sp. *A*										R	R			R	R

TABLE 6—(*Concluded*)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Globigerinoides sacculifera (Brady)	R								C	C	C	F	F	C	R
rubra (d'Orbigny)						R		F	A	C	C	F	F		F
conglobata (Brady)									R	A	A	F	C	F	F
helicina (d'Orbigny)											R				
Globigerinella aequilateralis (Brady)									F	C	F	R	F	C	F
Globigerinella sp. cf. *G. digitata* (d'Orbigny)											R				
Hastigerina pelagica (d'Orbigny)											R				
SUBFAMILY ORBULININAE															
Orbulina universa d'Orbigny									F	C	C	C	C	F	F
porosa Terquem											R	R			
sp. *A*									R	R	F		R		
SUBFAMILY PULLENIATININAE															
Pulleniatina obliquiloculata (Parker and Jones)									F	A	C	R	C	F	R
Sphaeroidinella dehiscens (Parker and Jones)						R			R	F	C	R	R	C	R
SUBFAMILY CANDEININAE															
Candeina nitida d'Orbigny										R	F				
FAMILY GLOBOROTALIIDAE															
Globorotalia tumida (Brady)								F	F	C	A	R	C	A	F
menardii (d'Orbigny)		R				R		F	C	A	A	F	F	F	R
fimbriata (Brady)											R			R	R
patagonica (d'Orbigny)										R					R
truncatulinoides (d'Orbigny)							R		F	C	C	C	A	R	C
crassa (d'Orbigny)						R			R	F	F		R	F	R
canariensis (d'Orbigny)										F			R	R	C
FAMILY ANOMALINIDAE															
SUBFAMILY ANOMALININAE															
Anomalina grosserugosa Gümbel	R					R	R		R		R		R		
ammonoides Reuss	R	R		R		R		R			R				
mississippiensis Cushman	R														
edwardsiana d'Orbigny	F					R	R		F						
foveolata Brady							R	R	R				F		
coronata Parker and Jones	R						R			R			R		
polymorpha Costa	R					R				R					
Planulina ariminensis d'Orbigny									R	R			R		
Laticarinina pauperata (Parker and Jones)										F	R		R		
SUBFAMILY CIBICIDINAE															
Cibicides akneriana d'Orbigny											R	R	F		
akneriana d'Orbigny var.											F		R		
sp. cf. *C. tenera* Brady													R	R	

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
mundula Brady, Parker and Jones										R			R		
haidingeri d'Orbigny										R	R		R	R	
ungeriana d'Orbigny							R	R	R	R		R	F	R	
ungeriana d'Orbigny var.										F	R	R	R		R
sp. cf. *C. praecincta* Karrer										R	R		F	F	
robertsoniana Brady													R		
refulgens Montfort	R									R					
dutemplei d'Orbigny									R	R					
advena d'Orbigny	R	F		R	R		F	F	F				R		
lobatula (Walker and Jacob)							R	R	F	R			R		
tumidula Brady						F	R								
wuellerstorfi Schwager							R		R	C	C	R	F	C	
sp. cf. *C. cora* d'Orbigny		F			F	R	R	F							
antillarum d'Orbigny								R							
sp. *A*								R							
sp. *B*							R	R							
sp. *C*						R									
sp. *D*						R									
sp. *E*													R		
sp. *F*													R		
sp. *G*													R		
sp. *H*													R		
sp. *I*										R					
Cibicidella sp. cf. *C. variabilis* (d'Orbigny)			R												R
FAMILY PLANORBULINIDAE															
Planorbulina mediterranensis d'Orbigny									R						
acervalis Brady	R			R		F	F	R							
sp. *A*				R				R							
Planorbulinella larvata (Parker and Jones)							R								
Gypsina globulus Reuss				R			R		F						
sp. *A*							R								
sp. *B*													R		
FAMILY RUPERTIIDAE															
Rupertia ? sp. *A*											R				
Carpenteria proteiformis Goës													R		
sp. *A*													R		
sp. *B*							R								
FAMILY HOMOTREMIDAE															
Homotrema rubrum (Lamarck)	R			F		R									
Polytrema miniacea (Pallas)			C												

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